PENTA LABORATORIES, INC.

312 NORTH NOPAL STREET • SANTA BARBARA, CALIFORNIA

PENTA *high-efficiency*

POWER TUBES

INTER-CHANGEABILITY TABLE

Type No.	Class	Manufacturer	Equivalent Penta Type No.
4-65A	Tetrode	Eimac, RCA	PL-4-65A, PL-177A*
4-125A	Tetrode	Eimac	PL-4D21, PL-4D21A**
4-125A/4D21	Tetrode	RCA	PL-4D21, PL-4D21A**
4-250A	Tetrode	Eimac	PL-5D22, PL-4-400A, PL-175A△
4-250A/5D22	Tetrode	RCA	PL-5D22, PL-4-400A, PL-175A△
4-400A	Tetrode	Eimac	PL-4-400A, PL-175A△
4-1000A	Tetrode	Eimac, RCA	PL-4-1000A
AX-4-125A/4D21	Tetrode	Amperex	PL-4D21, PL-4D21A**
AX-4-250A/5D22	Tetrode	Amperex	PL-5D22, PL-4-400A, PL-175A△
GL-4D21/4-125A	Tetrode	General Electric	PL-4D21, PL-4D21A**
GL-4-250A/5D22	Tetrode	General Electric	PL-5D22, PL-4-400A, PL-175A△
GL-4-400A	Tetrode	General Electric	PL-4-400A, PL-175A△
WL-4D21/4-125A	Tetrode	Westinghouse	PL-4D21, PL-4D21A**
WL-5D22/4-250A	Tetrode	Westinghouse	PL-5D22, PL-4-400A, PL-175A△
WL-4-400A	Tetrode	Westinghouse	PL-4-400A, PL-175A△
WL-4-1000A	Tetrode	Westinghouse	PL-4-1000A
4C35A	Hydrogen Thyratron	Kuthe	PL-165A°
4E27/8001	Pentode	RCA	PL-4E27A°°
4E27A/5-125B	Pentode	Eimac, RCA	PL-4E27A
5C22/HT-415	Hydrogen Thyratron	Kuthe	PL-5C22 (HT-415)
250R	Rectifier	Eimac	PL-250R
254W	Triode	Vacuum Tube Products	PL-254W
6155	Tetrode	Amperex	PL-4D21, PL-4D21A**
6156	Tetrode	Amperex	PL-5D22, PL-4-400A, PL-175A△
6268/AX-9911	Hydrogen Thyratron	Amperex	PL-165A°
6279/AX-9912	Hydrogen Thyratron	Amperex	PL-5C22 (HT-415)

* Pentode. Grid-plate and input capacitances slightly lower; output capacitance higher. Plate dissipation 75 watts. Pins 3 and 5 must be grounded. See data sheet.

** Has slightly higher output capacitance; plate dissipation 175 watts. See data sheet.

△ Pentode. Grid-plate capacitance slightly lower. Input and output capacitances higher. Higher maximum screen voltage rating. Tube base shell must be grounded to chassis. See data sheet.

° Requires 7.8 amperes heater current and 5 min. minimum heating time. Has higher anode voltage and current ratings. See data sheet.

°° Has slightly higher grid-to-plate capacitance. Slightly lower input and output capacitances. See data sheet.

15 December 1960
Form 536

PENTA LABORATORIES, INC.
312 NORTH NOPAL STREET • SANTA BARBARA, CALIFORNIA

PENTA HIGH-EFFICIENCY POWER TUBES

PL-172 Beam Pentode

PL-5C22/HT-415 Hydrogen Thyratron

PL-4-400A Tetrode

PL-165A Hydrogen Thyraton

PL-6549 Beam Pentode

PL-169A Vacuum Switch

Type	Fil. Volts	Fil. Current Amps.	Plate Diss. Max. W.	Plate Volt Max.	Plate Current Ma., Max.	Screen Voltage Max.	Price
BEAM PENTODES							
PL-172*†	6.0	8.2	1000	3,000	1000	600	$135.00
PL-175A*	5.0	14.5	400	4,000	350	800	50.00
PL-177A*	6.0	3.3	75	2,000	175	600	25.00
PL-6549	6.0	3.3	75	2,000	175	600	25.00
PL-4E27A	5.0	7.5	125	4,000	200	750	40.00
TETRODES							
PL-4D21 (4-125A)	5.0	6.5	125	3,000	225	600	36.00
PL-4D21A	5.0	6.5	175	3,000	225	600	37.50
PL-5D22 (4-250A)	5.0	14.5	250	4,000	350	800	46.50
PL-4-400A	5.0	14.5	400	4,000	350	800	48.00
TRIODES *(Grounded-Grid Types)*							
PL-6569	5.0	14.5	250	4,000	300	$\mu=45$	37.50
PL-6580	5.0	14.5	400	4,000	350	$\mu=45$	45.00
HIGH-VOLTAGE RECTIFIER							
PL-250R	5.0	10.5	...	60,000**	250	...	30.50
HYDROGEN THYRATRONS *(Low-Jitter Types)*							
PL-5C22/HT415	6.3	10.5	...	16,000	325 amp	...	36.00
PL-161	6.3	10.5	...	16,000	325 amp	...	48.00
PL-165A	6.3	7.8	...	12,000	225 amp	...	48.00
PL-174/6587	6.3	10.5	...	16,000	325 amp	...	48.00

*Zero-suppressor Voltage Type **Peak Inverse Voltage Rating †External Anode Type

VACUUM SWITCHES, Single-pole, Double-throw

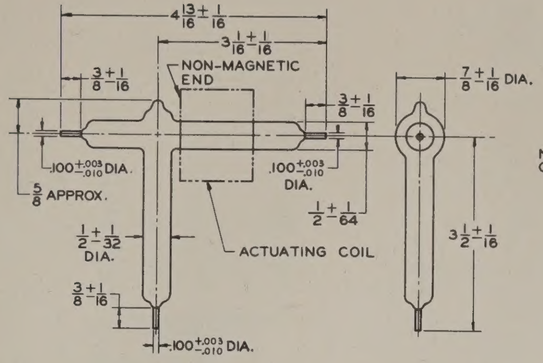
Type	Voltage, Maximum	Current Max. Amperes		Coil	Price
		AC or DC	Pulse		
PL-R1	21,000	6	150	Not supplied; requires 1100 Amp.—Turns	$33.00
PL-169A	21,000	30	500	Not supplied; requires 1900 Amp.—Turns	40.00
PL-186	21,000	6	...	Not supplied; requires 1000 Amp.—Turns	36.00
PL-187	21,000	30	500	Integral, 28 V, 500 Ma. D-C	58.00
PL-190	21,000	6	150	Integral, 28 V, 250 Ma. D-C	58.00
PL-191	21,000	6	...	Not supplied; requires 1000 Amp.—Turns	18.00

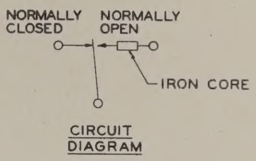
ACCESSORIES

Type	Description	Price
PL-C1	Glass Chimney for PL-4-400A and PL-175	$ 6.00
PL-184	Socket for PL-172, including chimney, built-in screen-grid and suppressor-grid by-pass capacitors	38.75
PL-184A	Socket for PL-172, including chimney and built-in screen-grid by-pass capacitors. Suppressor-grid grounded.	38.75
PL-C184	Plastic chimney, only, for PL-172	3.00

PENTA LABORATORIES, INC.
SANTA BARBARA, CALIFORNIA
Sales Representatives in Principal Cities

Form 532 R-2





CIRCUIT DIAGRAM

PL-R1

Vacuum Switch

The Penta PL-R1 vacuum relay is a single-pole double-throw switch enclosed in an evacuated glass envelope. The switch is designed to be operated by an external actuating coil. This external coil is excited by direct current, and is designed in such a manner that the soft-iron pole piece and the armature assembly enclosed in the envelope act to complete the magnetic circuit. Penta Laboratories, Inc. supplies only the glass-enclosed switch portion of the relay; the actuating coil may be obtained from several manufacturers.[1]

The Penta PL-R1 vacuum relay is suitable for applications where a compact, fast-acting relay is required to switch a high-voltage circuit under a wide range of ambient atmospheric conditions. It is especially suited to antenna changeover applications in compact airborne equipment. The PL-R1 may also be used for the switching of pulse-forming networks in airborne radar applications and in other compact military equipment. The unit also is well suited to switching applications in an explosive atmosphere.

ELECTRICAL CHARACTERISTICS

Peak-Voltage Rating (between open contacts)	21,000 volts
Peak-Current Rating (pulses, 5 μs. maximum duration)	150 amperes
Average-Current Rating (60 cycles a.c.)	6 amperes
Operation with Standard Coil (4500 turns, 128 ohms)	
Maximum Pull-In Current	115 ma.
Normal Operating Voltage	26 volts
Contact Assembly	Single-Pole Double Throw

MECHANICAL CHARACTERISTICS

Mounting Position	Any
Terminal Arrangement	See drawing
Maximum Overall Dimensions	
Length	4.88 inches
Width	4.19 inches
Net Weight (Maximum)	2 ounces
Ambient Temperature	—55 to +100° C.

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[1] Two such manufacturers are: Ratigan Electronics, Inc., 425 W. Cypress, Glendale, Calif., and Tur-Bo Jet Products, 424 So. San Gabriel Blvd., So. San Gabriel, Calif.

January 5, 1959

PENTA LABORATORIES, INC.
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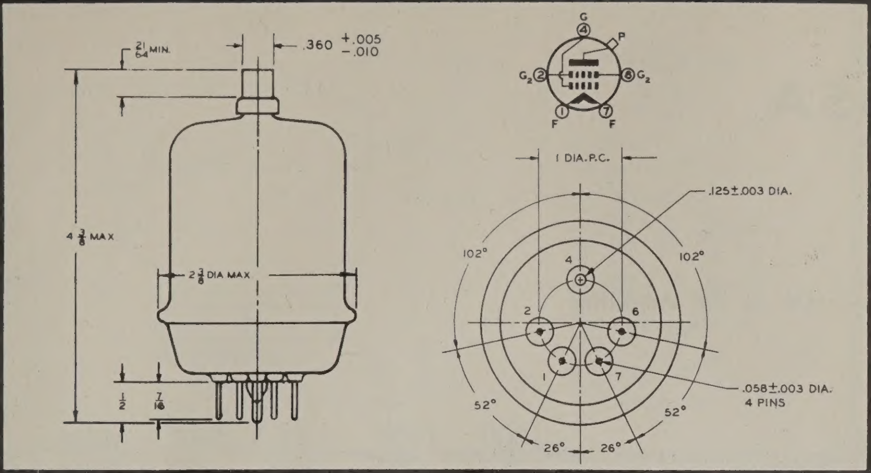

PL-4-65A

Power Tetrode

The PL-4-65A is a 65-watt power tetrode suitable for use as an r-f power amplifier and oscillator, and as an a-f power amplifier and modulator. Because of its compact size and quick-heating thoriated-tungsten filament, the PL-4-65A is especially useful in mobile communications equipment. The tube can be operated at full input at frequencies up to 150 Mc.

ELECTRICAL CHARACTERISTICS

Filament -- Thoriated Tungsten
  Voltage - - - - - - - - - - 6.0 volts
  Current - - - - - - - - - - 3.5 amperes

Grid-Screen Amplification Factor - - - - - - - - 5

Interelectrode Capacitances
  Grid-Plate - - - - - - - - - - .08 μμfd.
  Input - - - - - - - - - - 7.5 μμfd.
  Output - - - - - - - - - - 2.2 μμfd.

Transconductance (500 v. Eb, 125 ma. Ib, 250 v. Ec2) - - - - 4000 μmhos

MECHANICAL CHARACTERISTICS

Base[1] - - - - - - - - - - 5-pin Septar
Maximum Overall Dimensions
  Length - - - - - - - - - - 4.38 inches
  Diameter - - - - - - - - - - 2.38 inches
Mounting Position - - - - - - - - Vertical, base up or down

MAXIMUM RATINGS — C C S (Continuous Commercial Service)

	Class C CW or FM	Class C Telephony	
D-C Plate Voltage	3000	2500	max. volts
D-C Screen-Grid Voltage	600	400	max. volts
D-C Plate Current	150	120	max. ma.
Screen-Grid Input	10	10	max. watts
Plate Dissipation	65	45	max. watts

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[1] Fits E. F. Johnson Co. No. 122-101 or 122-247 sockets.

15 December 1960

PENTA LABORATORIES, INC.
312 NORTH NOPAL STREET • SANTA BARBARA, CALIFORNIA

PL-4-65A

TYPICAL OPERATION — Class-C CW or FM Amplifier

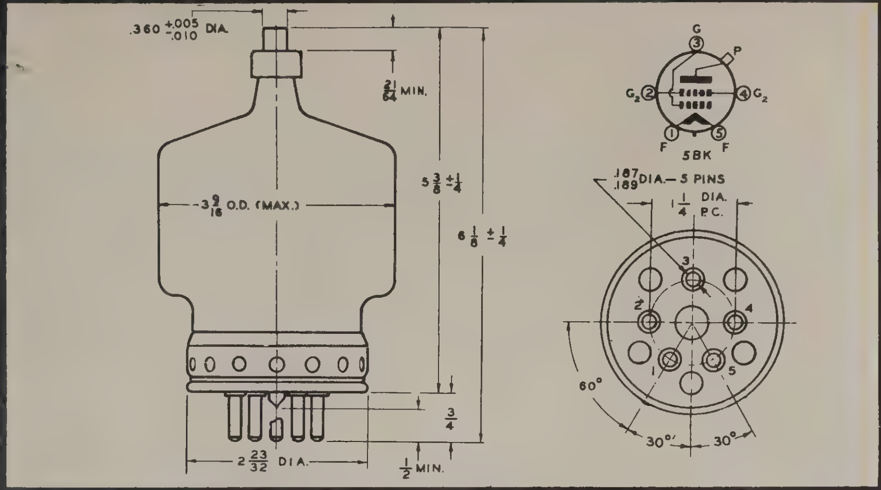
Grounded Cathode Circuit

D-C Plate Voltage	1000	1500	2000	3000	volts
D-C Screen-Grid Voltage	250	250	250	250	volts
D-C Control-Grid Voltage	-80	-85	-90	-100	volts
D-C Plate Current	150	150	140	115	ma.
D-C Screen-Grid Current	40	40	40	22	ma.
D-C Control-Grid Current	17	18	11	10	ma.
Peak R-F Grid Voltage (approx.)	175	180	190	170	volts
Driving Power (approx.)	3.0	3.2	2.1	1.7	watts
Plate Power Input	150	225	280	345	watts
Plate Dissipation	55	60	65	65	watts
Plate Power Output	95	165	215	280	watts

TYPICAL OPERATION — Class-C Amplitude-Modulated Amplifier, Carrier Conditions

Grounded-Cathode Circuit

D-C Plate Voltage	1000	1500	2000	2500	volts
D-C Screen-Grid Voltage	250	250	250	250	volts
D-C Control-Grid Voltage	-125	-125	-130	-135	volts
D-C Plate Current	120	120	120	110	ma.
D-C Screen-Grid Current	40	40	40	25	ma.
D-C Control-Grid Current	16	16	16	12	ma.
Peak R-F Grid Voltage (approx.)	220	220	225	215	volts
Driving Power (approx.)	3.5	3.5	3.6	2.6	watts
Plate Power Input	120	180	240	275	watts
Plate Dissipation	30	40	45	45	watts
Plate Power Output	90	140	195	230	watts



PL-4-400A

Power Tetrode

The Penta PL-4-400A is a power tetrode with a maximum plate dissipation rating of 400 watts. Cooling is by radiation and by forced air through the base, along the envelope, and over the plate seal and radiator-type plate connector. The unique Penta ribbed-plate construction utilized in the PL-4-400A provides a large effective plate radiating area, with minimum plate, screen-grid, and control-grid temperatures.

ELECTRICAL CHARACTERISTICS (Average)

Filament: Thoriated Tungsten	
Voltage (±5 per cent)	5.0 volts
Current	14.5 amperes
Grid-Screen mu factor	5.1
Transconductance (2500 v. Eb, 500 v. Ec2, 100 ma. Ib)	4000 umhos
Interelectrode Capacitances	
Grid-Plate	0.12 uuf.
Input	12.5 uuf.
Output	4.5 uuf.
Maximum Frequency for Full Ratings	110 Mc.

MECHANICAL CHARACTERISTICS

Mounting Position—Vertical, base down	
Base—5-pin metal shell	
Basing—RTMA type 5BK	
Maximum Overall Dimensions	
Length	3.56 inches
Diameter	6.38 inches
Net Weight	9.0 Ounces

Recommended Socket—Johnson 122-275, National HX-100, or equivalent, operated in conjunction with the PL-C1 glass chimney with socket cutout as shown in this bulletin.

December 30, 1958

PENTA LABORATORIES, INC.
312 NORTH NOPAL STREET • SANTA BARBARA, CALIFORNIA

COOLING

Forced air cooling of the base, base seals, envelope, plate seal, and plate connector is required for all classes of operation when the PL-4-400A is operated at or near the maximum plate dissipation rating. A total quantity of 15 cubic feet per minute of cooling air, properly distributed to the base, envelope, and plate seal area, is required. Such cooling is most conveniently provided by means of a pressurized chassis upon which a standard tube socket is mounted in a special cut-out, in conjunction with a Penta PL-C1 air-control glass chimney. Proper dimensions for the socket cut-out to provide correct aid distribution to the various portions of the tube are given on page 4 of this bulletin. Alternatively, a commercially available air-distribution type socket may be used with the PL-4-400A.

When used with a socket cut-out as illustrated on page 4 and the PL-C1 chimney, the PL-4-400A will be adequately cooled for operation at maximum ratingss when the pressure within the sealed chassis is equal to 0.4 inch of water. At this pressure, the required 15 cfm air flow will be obtained. Air at the proper pressure and quantity may be obtained from a small centrifugal blower rated at about 100 cfm of free air. Cooling is adequate when the base seal temperatures does not exceed 200° and the plate seal temperature does not exceed 225°C.

When the plate dissipation does not exceed 250 watts, and when operation is at frequencies below 30 Mc., the PL-4-400A may be operated without forced envelope or plate seal cooling. Under these circumstances, an air flow of 5 cubic feet per minute through the base alone is required, however.

RADIO FREQUENCY OPERATION

The PL-4-400A is especially suited for use as a radio-frequency power amplifier. The compact construction and low interelectrode capitances permit operation at full ratings at frequencies as high as 110 Mc. Neutralization normally is not required for operation at frequencies below 30 Mc. At frequencies above 45 to 50 Mc. the feedback within the tube is substantially the result of screen-lead inductance. The effect of screen-lead inductance may be eliminated for a specified frequency of operation through the use of variable capacitor as the screen-lead by-pass. This capacitor is tuned for minimum feedback of energy from the plate circuit back to the grid circuit. A variable capacitor with a maximum capacitance of 50 uuf. normally will be found adequate for operation in the 100-Mc. region.

Under normal operating conditions the PL-4-400A requires an unusually small amount of driving power. The high power sensitivity of the tube permits a reduction in the power requirements imposed upon the preceding driver stage, but requires that adequate precautions be taken to minimize the feedback of energy from the output circuit back to the input circuit of the tube.

AUDIO-FREQUENCY OPERATION

The high power sensitivity of the PL-4-400A makes it well suited for use as an audio-frequency power amplifier or modulator in push-pull Class AB_1 or Class AB_2 service. In these classes of operation a pair of PL-4-400A's can give relatively high audio-frequency power output with low driving power and low harmonic distortion.

Under Class AB_2 operating conditions both grid bias and screen voltage must be obtained from a source having relatively good regulation. A series-connected string of voltage regulator tubes connected so as to regulate the output voltage of the screen-voltage supply normally will prove adequate. Grid-bias voltage may be obtained from batteries or from a power supply having a low resistance bleeder.

Under Class AB_1 operating conditions, the d-c screen voltage must be obtained from a supply having good regulation, but the internal impedance of the grid-bias supply is not of critical importance. However, the effective grid-circuit resistance per tube must not exceed 250,000 ohms.

MAXIMUM RATINGS—CCS (Continuous Commercial Service)

(Frequencies below 110 Mc.)

	Class C FM or C.W.	Plate Mod. Class C	Class AB_1 Audio Ampl.	Class AB_2 Audio Ampl.	
DC Plate Voltage	4000	3200	4000	4000	volts
D-C Screen Voltage	600	600	800	800	volts
D-C Grid Bias	—500	—500			volts
D-C Plate Current	350	275	350	350	ma.
Plate Dissipation	400	270	400	400	watts
Screen Dissipation	35	35	35	35	watts
Grid Dissipation	10	10	10	10	watts

TYPICAL OPERATION—Class C CW or FM Amplifier (Frequencies below 75 Mc.)

D-C Plate Voltage	2500	3000	4000	volts
D-C Screen Voltage	500	500	500	volts
D-C Grid Voltage	—200	—220	—220	volts
D-C Plate Current	350	350	350	ma.
D-C Screen Current	46	46	42	ma.
D-C Grid Current	18	18	19	ma.
Plate Dissipation	235	250	300	watts
Screen Dissipation	23	23	21	watts
Grid Dissipation	1.8	1.8	1.8	watts
Peak R-F Grid Voltage (approx.)	300	320	320	volts
Driving Power (at 20 Mc.)	5.5	5.9	6.0	watts
Plate Power Input	875	1050	1400	watts
Plate Power Output	640	800	1100	watts

Note: Driving power increases with operating frequency until at 75 Mc. approximately twice as much driving power as shown above will be required.

TYPICAL OPERATION—Class AB$_1$ A-F Power Amplifier or Modulator (Sine wave, two tubes)

D-C Plate Voltage	2500	3000	4000	volts
D-C Screen Voltage	750	750	750	volts
D-C Grid Voltage*	—130	—140	—150	volts
Zero Signal D-C Plate Current	190	160	120	ma.
Max.-Signal D-C Plate Current	635	610	585	ma.
Zero-Signal D-C Screen Current	0	0	0	ma.
Max.-Signal D-C Screen Current	28	30	40	ma.
Plate-to-Plate Load Resistance	6800	9000	14,500	ohms
Peak A-F Grid-to-Grid Signal	255	275	295	volts
Driving Power	0	0	0	watts
Max-Signal Plate Dissipation (per tube)	370	400	400	watts
Max.-Signal Plate Power Output	850	1100	1550	watts

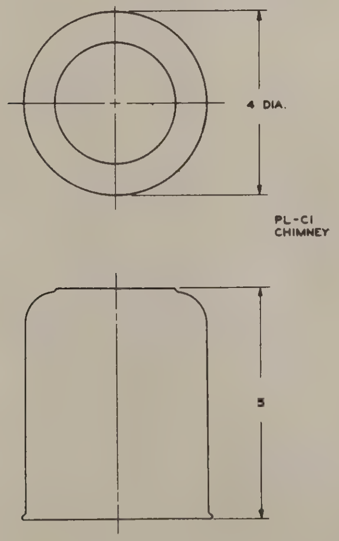
TYPICAL OPERATION—Class C. Amplitude-Modulated Amplifier, Carrier Conditions (Frequencies below 75 Mc.)

D-C Plate Voltage	2000	2500	3000	volts
D-C Screen Voltage	500	500	500	volts
D-C Grid Voltage	—220	—220	—220	volts
D-C Plate Current	275	275	275	ma.
D-C Screen Current	30	28	26	ma.
D-C Grid Current	12	12	12	ma.
Plate Dissipation	170	180	195	watts
Screen Dissipation	15	14	13	watts
Grid Dissipation	1.1	1.1	1.1	watts
Peak A-F Screen Voltage	350	350	350	volts
Peak R-F Grid Voltage (approx.)	290	290	290	volts
Driving Power (approx.)	3.5	3.5	3.5	watts
Plate Power Input	550	688	825	watts
Plate Power Output	380	508	630	watts

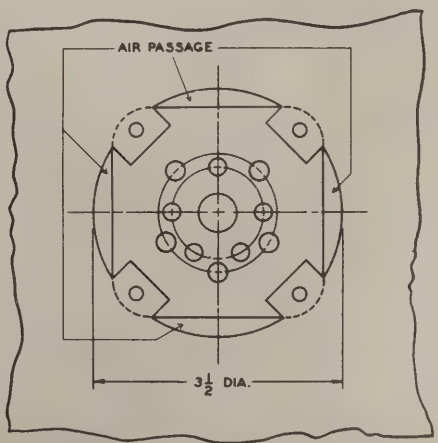
TYPICAL OPERATION—Class AB$_2$ A-F Power Amplifier or Modulator (Sine wave, two tubes)

D-C Plate Voltage	2500	3000	4000	volts
D-C Screen Voltage	500	500	500	volts
D-C Grid Voltage*	—75	—80	—90	volts
Zero-Signal D-C Plate Current	190	160	120	ma.
Max.-Signal D-C Plate Current	700	700	640	ma.
Zero-Signal D-C Screen Current	0	0	0	ma.
Max.-Signal D-C Screen Current	50	40	32	ma.
Plate-to-Plate Load Resistance	7200	9000	14,000	ohms
Peak A-F Grid-to-Grid Signal	265	280	280	volts
Average Driving Power (Max. signal)	4.3	4.5	3.5	watts
Peak Driving Power (Max. signal)	9	10	8	watts
Max-Signal Plate Dissipation (per tube)	320	400	400	watts
Max-Signal Plate Power Output	1100	1380	1750	watts

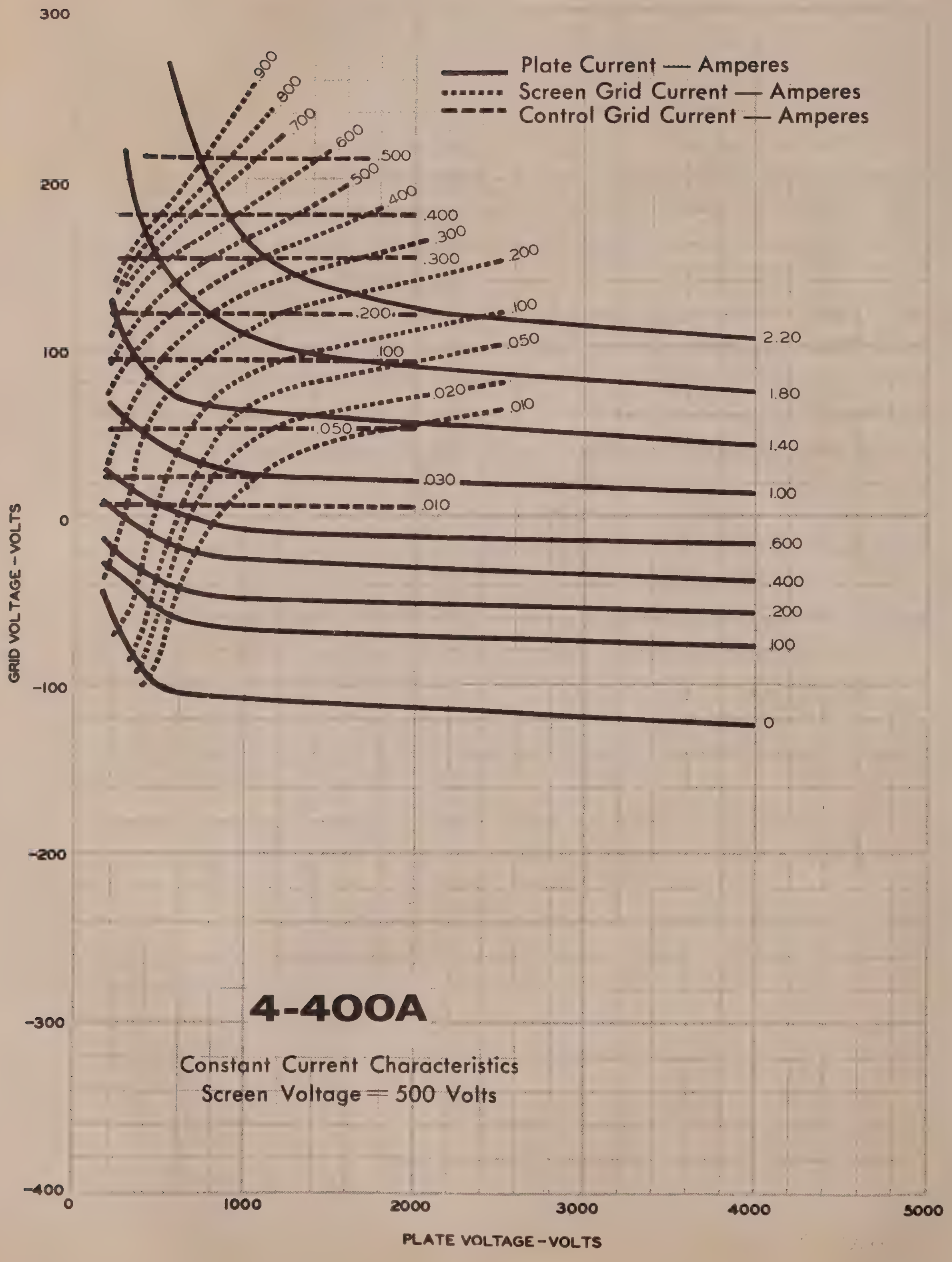
*Note: Approximate values. Adjust to give the stated value of zero-signal plate current.



PL-C1 CHIMNEY

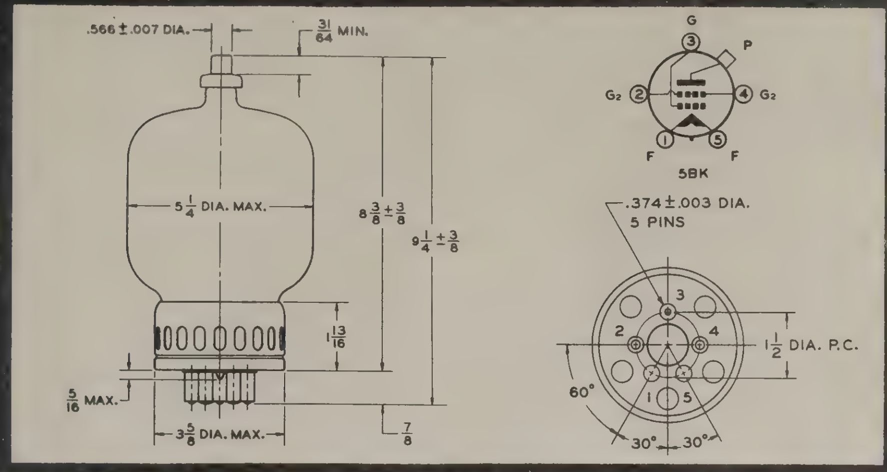


CHASSIS CUT-OUT AND SOCKET MOUNTING FOR PROPER AIR DISTRIBUTION FROM PRESSURIZED CHASSIS (JOHNSON NO. 122-275 SOCKET)



4-400A

Constant Current Characteristics
Screen Voltage = 500 Volts



PL-4-1000A

Power Tetrode

The PL-4-1000A is a beam power tetrode with a plate dissipation rating of 1000 watts. It is suitable for use as an r-f power amplifier and oscillator, and as an a-f amplifier and modulator. The PL-4-1000A can be used at frequencies up to 110 Mc. Cooling of the tube is achieved by radiation from the plate and by circulation of forced-air through the base and around the envelope.

ELECTRICAL CHARACTERISTICS

Filament -- Thoriated Tungsten	
Voltage	7.5 volts
Current	21 amperes
Grid-Screen Amplification Factor	7
Interelectrode Capacitances	
Grid-Plate	0.25 μμfd.
Input	28.0 μμfd.
Output	8.1 μμfd.
Transconductance (2500 v Eb, 300 ma. Ib, 500 v. Ec2)	10,000 μmhos

MECHANICAL CHARACTERISTICS

Base	5-pin metal shell (see drawing)
Maximum Overall Dimensions	
Length	9.63 inches
Diameter	5.25 inches
Mounting Position	Vertical, base up or down

MAXIMUM RATINGS — C C S (Continuous Commercial Service)

	Class C CW or FM	Class C Telephony	
D-C Plate Voltage	6000	5000	max. volts
D-C Screen-Grid Voltage	1000	1000	max. volts
D-C Plate Current	700	600	max. ma.
Screen-Grid Input	75	75	max. watts
Plate Dissipation	1000	670	max. watts

15 December 1960

PENTA LABORATORIES, INC.

312 NORTH NOPAL STREET • SANTA BARBARA, CALIFORNIA

Form 538

PL-4-1000A

TYPICAL OPERATION — Class-C CW or FM Amplifier

Grounded-Cathode Circuit

(Frequencies up to 30 Mc.)

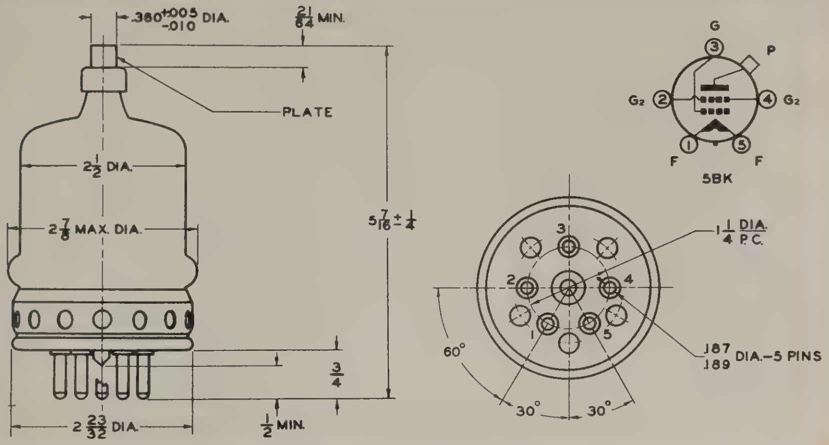
D-C Plate Voltage	3000	4000	5000	6000	volts
D-C Screen-Grid Voltage	500	500	500	500	volts
D-C Control-Grid Voltage	-150	-150	-200	-200	volts
D-C Plate Current	700	700	700	700	ma.
D-C Screen-Grid Current	146	137	147	140	ma.
D-C Control-Grid Current	38	39	45	42	ma.
Peak R-F Grid Voltage (approx.)	290	290	355	350	volts
Driving Power (approx.)	11	12	16	15	watts
Plate Power Input	2100	2800	3500	4200	watts
Plate Dissipation	670	700	690	800	watts
Plate Power Output	1430	2100	2810	3400	watts

TYPICAL OPERATION — Class-C Amplitude-Modulated Amplifier, Carrier Conditions

Grounded Cathode Circuit

(Frequencies up to 30 Mc.)

D-C Plate Voltage	3000	4000	5000	5500	volts
D-C Screen-Grid Voltage	500	500	500	500	volts
D-C Control-Grid Voltage	-200	-200	-200	-200	volts
D-C Plate Current	600	600	600	600	ma.
D-C Screen-Grid Current	145	132	130	105	ma.
D-C Control-Grid Current	36	33	33	28	ma.
Peak R-F Grid Voltage (approx.)	340	335	335	325	volts
Driving Power (approx.)	12	11	11	9	watts
Plate Power Input	1800	2400	3000	3300	watts
Plate Dissipation	410	490	560	670	watts
Plate Power Output	1390	1910	2440	2630	watts



PL-4D21

Power Tetrode

The Penta PL-4D21 is a power tetrode with a maximum plate dissipation rating of 125 watts. Cooling for normal operation with a radiator-type plate connector is by radiation and by convective air flow through the base and alongside the envelope. Forced cooling of the envelope and the radiator-type connector by a small fan or blower is required for normal operation on frequencies above 30 Mc. and for operation under maximum ICAS ratings at all frequencies. Forced cooling of the seals at the base is required when free circulation of air through the base is prevented by shielding or other obstruction.

ELECTRICAL CHARACTERISTICS (Average)

Filament: Thoriated Tungsten		
Voltage (± 5 per cent)	5.0	volts
Current	6.5	amperes
Grid-Screen mu factor	5.9	
Transconductance (2500 v. E_b, 400 v. E_{c2}, 50 ma. I_b)	2500	µmhos
Interelectrode Capacitances		
Grid-plate	0.05	µµf.
Input	10.8	µµf.
Output	3.1	µµf.
Maximum Frequency for Full Ratings	120	Mc.

MECHANICAL CHARACTERISTICS

Mounting Position—Vertical, base up or down

Base—5 pin metal shell

Basing—RTMA type 5BK

Maximum Overall Dimensions	
Length	5.69 inches
Diameter	2.82 inches
Net weight	6.5 ounces

Recommended socket—Johnson 122-275, National HX-100, or equivalent.

July 20, 1959

OPERATION

The PL-4D21 is especially suited for use as a radio-frequency power amplifier. The compact construction and low interelectrode capacities permit operation at full ratings for continuous service at frequencies as high as 120 Mc. Operation at reduced ratings may be attained at frequencies as high as 240 Mc. The PL-4D21 may also be used as an audio-frequency power amplifier and modulator.

Under normal operating conditions the PL-4D21 requires an unusually small amount of driving power for a specified value of plate power output. The high power sensitivity of the tube permits a reduction in the power requirements imposed upon the preceding driver stage, but requires that adequate precautions be taken to minimize the feedback of energy from the output circuit back to the input circuit of the tube.

Maximum ratings and typical operating conditions are given for ICAS (Intermittent Commercial and Amateur Service) operation in addition to the standard CCS (Continuous Commercial Service) ratings. ICAS ratings and operating conditions may be used for those classes of intermittent service on frequencies below 30 Mc. where the number of plate-power hours is materially less than the hours of filament operation.

MAXIMUM RATINGS—CCS (Continuous Commercial Service)

Frequencies up to 120 Mc.	Class C FM or C.W.	Plate Mod. Class C	Class AB_1 Audio Ampl.	Class AB_2 Audio Ampl.
D-C Plate Volts	3000	2500	3000	3000 volts
D-C Screen Volts	400	400	600	400 volts
D-C Grid Bias	—500	—500		volts
D-C Plate Current	225	200	225	225 ma.
Plate Dissipation	125	85	125	125 watts
Screen Dissipation	20	20	20	20 watts
Grid Dissipation	5	5		watts

MAXIMUM RATINGS—ICAS (Intermittent Commercial and Amateur Service)

Frequencies up to 30 Mc.	Class C FM or C.W.	Plate Mod. Class C	Class AB_2 Audio Ampl.
D-C Plate Voltage	4000	3200	3200 volts
D-C Screen Voltage	400	400	400 volts
D-C Grid Bias	—500	—500	volts
D-C Plate Current	225	200	250 ma.
Plate Dissipation	125	100	125 watts
Screen Dissipation	20	20	20 watts
Grid Dissipation	5	5	watts

TYPICAL OPERATION—Class C C-W or FM Amplifier

	CCS—Frequencies below 120 Mc.			*ICAS—Below 30 Mc.*	
D-C Plate Voltage	2000	2500	3000	4000	volts
D-C Screen Voltage	350	350	350	350	volts
D-C Grid Voltage	–100	–150	–150	–350	volts
D-C Plate Current	200	200	167	156	ma.
D-C Screen Current	50	40	30	16	ma.
D-C Grid Current	12	12	9	8	ma.
Plate Dissipation	125	125	125	125	watts
Screen Dissipation	18	14	10.5	5.6	watts
Grid Dissipation	1.6	2.0	1.2	1.0	watts
Peak R-F Grid Voltage (Approx.)	230	320	280	480	volts
Driving Power (Approx.)	2.8	3.8	2.5	3.8	watts
Plate Power Input	400	500	500	625	watts
Plate Power Output	275	375	375	500	watts

TYPICAL OPERATION—Class C Amplitude-Modulated Amplifier, Carrier Conditions

	CCS—Frequencies below 120 Mc.		*ICAS—Below 30 Mc.*	
D-C Plate Voltage	2000	2500	3200	volts
D-C Screen Voltage	350	350	350	volts
D-C Grid Voltage	–220	–210	–335	volts
D-C Plate Current	150	152	156	ma.
D-C Screen Current	33	30	21	ma.
D-C Grid Current	10	9	8.5	ma.
Plate Dissipation	75	80	100	watts
Screen Dissipation	11.5	10.5	7.5	watts
Grid Dissipation	1.6	1.4	1.1	watts
Peak A-F Screen Voltage	210	210	240	volts
Peak R-F Grid Voltage (Approx.)	375	360	465	volts
Driving Power (Approx.)	3.8	3.3	4.0	watts
Plate Power Input	300	380	500	watts
Plate Power Output	225	300	400	watts

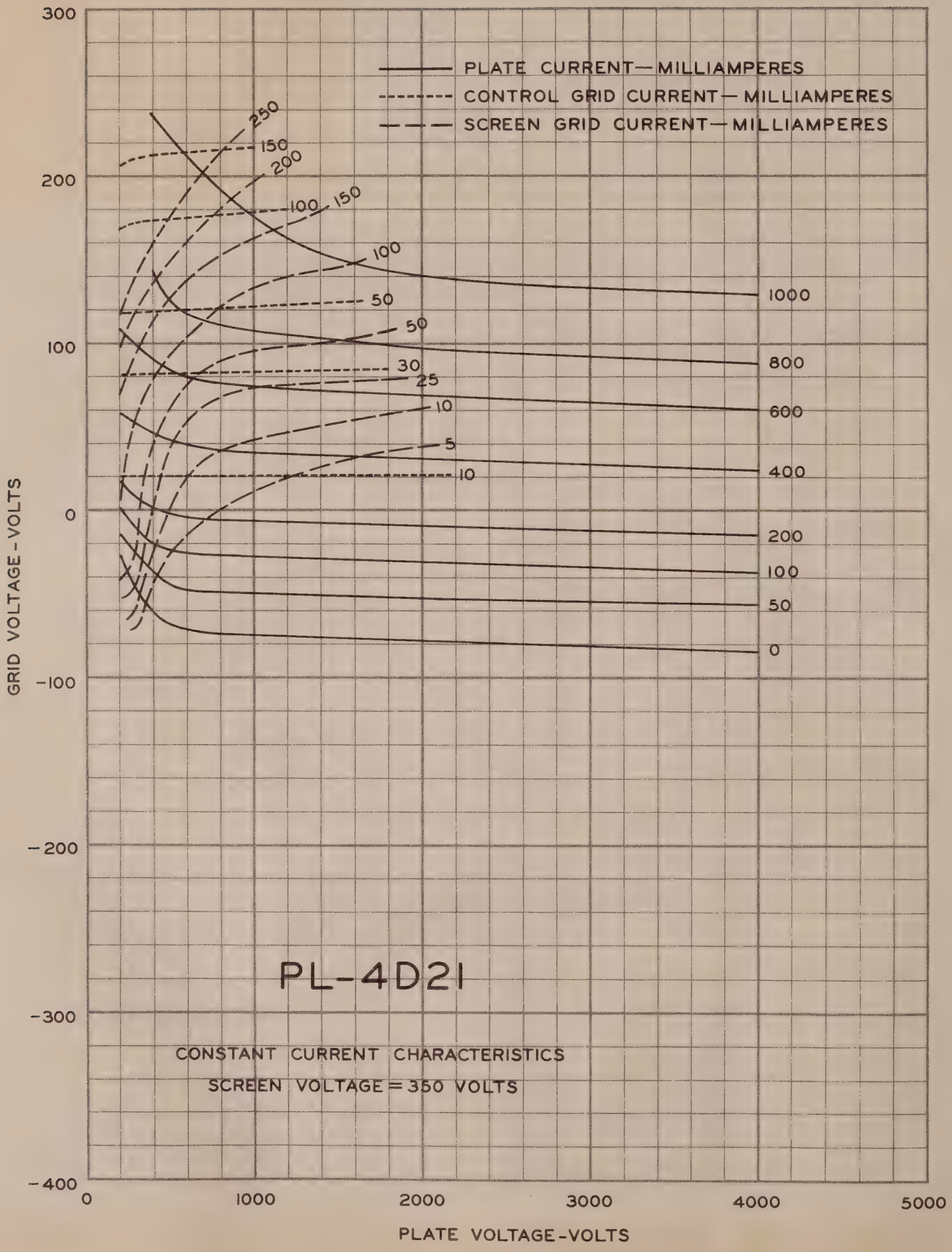
TYPICAL OPERATION—Class AB_1 A-F Power Amplifier or Modulator (Sine wave, two tubes)

D-C Plate Voltage	1500	2000	2500	volts
D-C Screen Voltage	600	600	600	volts
D-C Grid Voltage	–90	–94	–96	volts
Zero-Sig. D-C Plate Current	60	50	50	ma.
Max.-Sig. D-C Plate Current	222	240	232	ma.
Zero-Sig. D-C Screen Current	–1.0	–0.5	–0.3	ma
Max.-Sig. D-C Screen Current	17	6.4	8.5	ma.
Plate-to-Plate Load Resistance	10,200	13,400	20,300	ohms
Peak A-F Grid-to-Grid Signal	180	188	192	volts
Driving Power	0	0	0	watts
Max.-Sig. Plate Diss. (per tube)	87.5	125	125	watts
Max.-Sig. Plate Power Output	158	230	330	watts
Total Harmonic Distortion	5	2	2.6	per cent

TYPICAL OPERATION—Class AB_2 A-F Power Amplifier or Modulator (Sine wave, two tubes)

	CCS			*ICAS*	
D-C Plate Voltage	1500	2000	2500	3000*	volts
D-C Screen Voltage	350	350	350	350	volts
D-C Grid Voltage	–41	–45	–43	–50	volts
Zero-Sig. D-C Plate Current	87	72	93	61	ma.
Max.-Sig. D-C Plate Current	400	300	260	280	ma.
Zero-Sig. D-C Screen Current	0	0	0	0	ma.
Max.-Sig. D-C Screen Current	34	14	16	9	ma.
Plate-to-Plate Load Resistance	7200	13,600	22,200	22,700	ohms
Peak A-f Grid-to-Grid Signal	282	210	178	188	volts
Average Driving Power (Max. Sig.)	2.5	1.4	1.0	0.85	watts
Peak Driving Power (Max. Sig)	5.2	3.1	2.4	1.8	watts
Max.-Sig. Plate Diss. (per tube)	125	125	122	148*	watts
Max.-Sig. Plate Power Output	350	350	400	550	watts
Total Harmonic Distortion	2.5	1.0	2.2	2.6	pct.

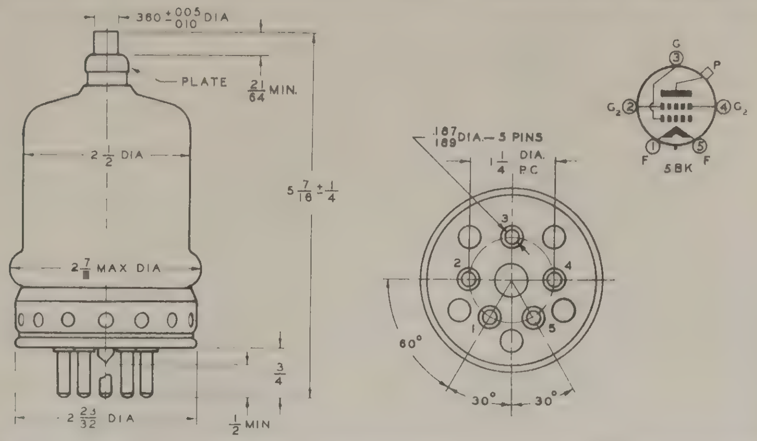
*Note—This set of operating conditions is for voice work of an intermittent nature and cannot be used at full signal for testing with a sine wave. In any event, average plate dissipation with normal voice modulation must not exceed 125 watts per tube.



PL-4D21

CONSTANT CURRENT CHARACTERISTICS

SCREEN VOLTAGE = 350 VOLTS



PL-4D21A

Power Tetrode

The PL-4D21A is a 175-watt dissipation radiation-cooled power tetrode unilaterally interchangable with the 4D21/4-125A. The PL-4D21A may be substituted for the 4D21/4-125A in all applications without circuit changes. Because of the increased plate radiating area made possible by the unique Penta ribbed design, direct substitution of the PL-4D21A will result in cooler tube operation. Where circuits allow increased input, and where a small amount of air cooling can be supplied, substitution of the PL-4D21A in equipment designed for the 4D21/4-125A will allow a substantial increase in useful power output.

ELECTRICAL CHARACTERISTICS

Filament -- Thoriated Tungsten	
Voltage	5.0 volts
Current	6.5 amperes
Grid-Screen mu Factor	5.9
Transconductance (2500 v. Eb, 400 v. Ec_2, 70 ma. Ib)	3050 μmhos
Interelectrode Capacitances	
Grid-Plate	0.05 μμf
Input	10.8 μμf
Output	3.3 μμf

MECHANICAL CHARACTERISTICS

Base	5-pin, metal shell
Basing	EIA type 5 BK
Mounting Position	Vertical, base up or down
Maximum Overall Dimensions	
Length	5.69 inches
Diameter	2.82 inches
Net Weight	6.5 ounces

MAXIMUM RATINGS (Continuous Commercial Service)

	Class C FM or CW	Class C Plate Mod[2]	Class AB_1 Audio	Class AB_2 Audio	
D-C Plate Voltage	3000	2500	3000	3000	volts max.
D-C Screen Voltage	400	400	600	400	volts max.
D-C Grid Voltage	-500	-500	-500	-500	volts max.
D-C Plate Current	225	200	225	225	ma. max.
Plate Dissipation[1]	175	115	175	175	watts max.
Screen Dissipation	20	20	20	20	watts max.
Grid Dissipation	5	5	5	5	watts max.

---

[1] Base and envelope cooling by normal convection is adequate for plate dissipation up to 125 watts. When plate dissipation exceeds 125 watts, forced air cooling of both base and envelope are required. When cooling is required, 5 c.f.m. of cooling air should be passed through the base, and small fan delivering 50-100 c.f.m. of free air should be directed at the upper portion of the tube envelope. Envelope cooling is adequate when plate seal and envelope temperatures do not exceed 200° C.

[2] Carrier conditions.

31 March 1960

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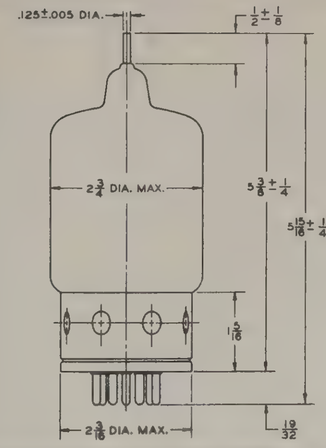
Form No. 508R-1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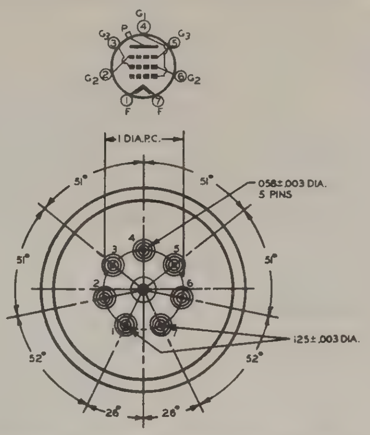


PL-4E27A

Beam Pentode

The Penta PL-4E27A is a beam pentode suitable for use as an amplifier, oscillator, or modulator. In Class-C service it will deliver over 400 watts of usable power output with approximately two watts driving power. As a Class-AB_1 linear amplifier, the PL-4E27A will provide up to 280 watts of usable power output.

The PL-4E27A has a maximum plate dissipation rating of 125 watts and a maximum plate voltage rating of 4000 volts at frequencies up to 75 Mc. Adequate cooling is provided by convection and radiation, except in high ambient temperatures and at frequencies above 75 Mc., where forced-air circulation may be necessary.

ELECTRICAL CHARACTERISTICS

Filament: Thoriated tungsten	
Voltage	5.0 volts
Current	7.5 amperes
Grid-Screen Mu Factor	5.0
Interelectrode Capacitance	
Grid-Plate	0.08 $\mu\mu$f
Input	10.5 $\mu\mu$f
Output	4.7 $\mu\mu$f
Transconductance (2500 v. E_b, 500 v. E_{c2}, 0 v. E_{c3}, 50 ma. I_b)	2500 μmhos
Maximum Frequency for Full Ratings	75 Mc.

MECHANICAL CHARACTERISTICS

Mounting Position	Vertical, base up or down
Base	Giant 7-pin, metal shell
Connections	See drawing
Maximum Overall Dimensions	
Length	6.19 inches
Diameter	2.75 inches
Net Weight (average)	6 ounces

Recommended socket -- E. F. Johnson Co. No. 122-237 or equivalent

May 1, 1960

MOUNTING

The PL-4E27A must be mounted vertically, base up or down. The metal base should be grounded. The plate lead should be flexible.

The tube base fits E. F. Johnson Co. No. 122-237 seven-pin ceramic socket. This socket has a central ventilating hole, and if a socket made by another manufacturer is used, it should be made certain that the socket has a similar hole.

COOLING

A heat-dissipating connector must be used at the plate terminal, and provisions made for the circulation of air through the socket and the hole of the base.

Although convection and radiation cooling will normally be adequate when the tube is operating at frequencies below 75 Mc., it may be necessary to provide forced-air cooling at higher frequencies. The temperature of the plate and base seals must not exceed 225° C. Forced-air cooling, regardless of frequency, will be beneficial to the tube.

Metal-based tubes, such as the PL-4E27A, should not be sub-mounted. Sub-mounting does not improve isolation of the input and output circuits, and can prevent the proper circulation of cooling air.

OPERATION — GENERAL

Maximum ratings and typical operating conditions for the PL-4E27A are given in the accompanying tabular data.

Filament voltage should be maintained as closely as possible to the rated value of 5.0 volts. Variations up to 10 per cent of this value are permissible, but decreased tube life and variations in power output may occur with prolonged operation at voltages more than five per cent from the rated value.

Screen-grid input exceeding the maximum rating can cause permanent damage to the PL-4E27A. If screen voltage is obtained from a power supply separate from the plate voltage supply, the circuit should be arranged so that it is impossible to apply screen voltage without plate voltage.

RADIO-FREQUENCY OPERATION

When care is taken to isolate the input and output circuits, and the suppressor and screen grids are effectively grounded for radio frequencies, the PL-4E27A may in most cases be operated without neutralization. In low-distortion Class-AB linear amplifier service, where reaction on the driver circuit must be eliminated entirely, it is good practice to neutralize the small feedback capacitance of the tube.

For maximum power gain and efficiency, the screen voltage applied to the tube in r-f amplifier applications should be no less than 500 volts, and a positive voltage of approximately 60 volts should be applied to the suppressor grid. The tube may be operated with a screen voltage as low as 350 volts, and with the suppressor grid operated at zero potential. However, either of these conditions will result in an increase in driving power requirements. Additionally, efficiency at low plate voltages will be sacrificed with zero-voltage operation of the suppressor grid.

In Class-AB linear amplifier service, the screen voltage for the PL-4E27A must be obtained from a well-regulated source, to prevent excessive screen voltage variations due to the changes in screen current which occur between zero-signal and full-signal conditions.

The suggested Class-AB$_1$ linear r-f amplifier operating conditions tabulated on page three result in third-order distortion products approximately 25 db below peak envelope power output, without the use of degenerative feedback.

In Class-AB applications, grid bias voltage for the PL-4E27A must be obtained from a fixed bias supply. The internal resistance of the bias source should not exceed 2000 ohms. Partial grid leak bias, in combination with fixed or cathode bias, or both, may be used in Class-C application.

MAXIMUM RATINGS

CCS (Continuous Commercial Service)

	Class C CW or FM	Class AB$_2$ Audio or R-F	Class AB$_1$ Audio or R-F	
D-C Plate Voltage	4000	4000	4000	volts
D-C Screen-Grid Voltage	750	750	750	volts
D-C Suppressor-Grid Voltage	75	75	75	volts
D-C Control-Grid Voltage	-500			volts
D-C Plate Current	200	200	200	ma.
D-C Control-Grid Current	10	10		ma.
Control-Grid Dissipation	5	5		watts
Screen-Grid Input	20	20	20	watts
Suppressor-Grid Input	20	20	20	watts
Plate Dissipation	125	125	125	watts

Suppressor grid voltage may be obtained from any source capable of supplying approximately 60 volts at 10 ma. Although the suppressor grid voltage requirements are not critical, the voltage should be between 50 and 100 volts for best utilization of the suppressor grid action. A convenient source of suppressor grid voltage is a high-resistance voltage divider between the screen grid and ground.

High-level plate modulation may be accomplished with any of the systems commonly used for screen-grid tubes: by supplying the screen grid through a series resistor from either the modulated or unmodulated plate supply or through an audio-frequency reactor from a separate low-voltage source.

Where maximum extended upward modulation above 100 per cent is desired, it is recommended that modulated voltage be applied to the screen grid. This can be accomplished by taking the screen voltage from the modulated plate supply through a series resistor or, if a low-voltage supply and series screen reactor are used, by connecting a low-capacitance audio coupling capacitor between the screen grid and the modulated plate supply.

Modulation of the suppressor voltage is not necessary in high-level modulated applications. However, the tube and its performance will not be adversely affected if it is necessary to obtain the suppressor grid voltage from the modulated screen supply.

TYPICAL OPERATION — Class AB, Linear R-F Amplifier[1]
Single-Sideband, Suppressed Carrier
Grounded Cathode Circuit

D-C Plate Voltage	2000	2000	2500	2500	volts
D-C Screen-Grid Voltage	750	750	750	750	volts
D-C Suppressor-Grid Voltage	0	60	0	60	volts
D-C Control-Grid Voltage[2]	-130	-132	-134	-136	volts
Zero-Signal D-C Plate Current	40	40	35	35	ma.
Zero-Signal D-C Screen Current	0.5	0.5	0.2	0.2	ma.
Maximum-Signal D-C Plate Current	165	180	165	170	ma.
Maximum-Signal D-C Screen Current	25	16	19	15	ma.
Maximum-Signal Peak R-F Grid Voltage	130	132	134	136	volts
Maximum-Signal Power Input	330	360	413	425	watts
Maximum-Signal Plate Dissipation	125	125	125	125	watts
Maximum-Signal Useful Power Output[3]	195	220	265	280	watts

[1] D-C Current values shown are for peak conditions, or for single-tone modulation at full signal.

[2] Approximate value; adjust to give stated zero-signal plate current.

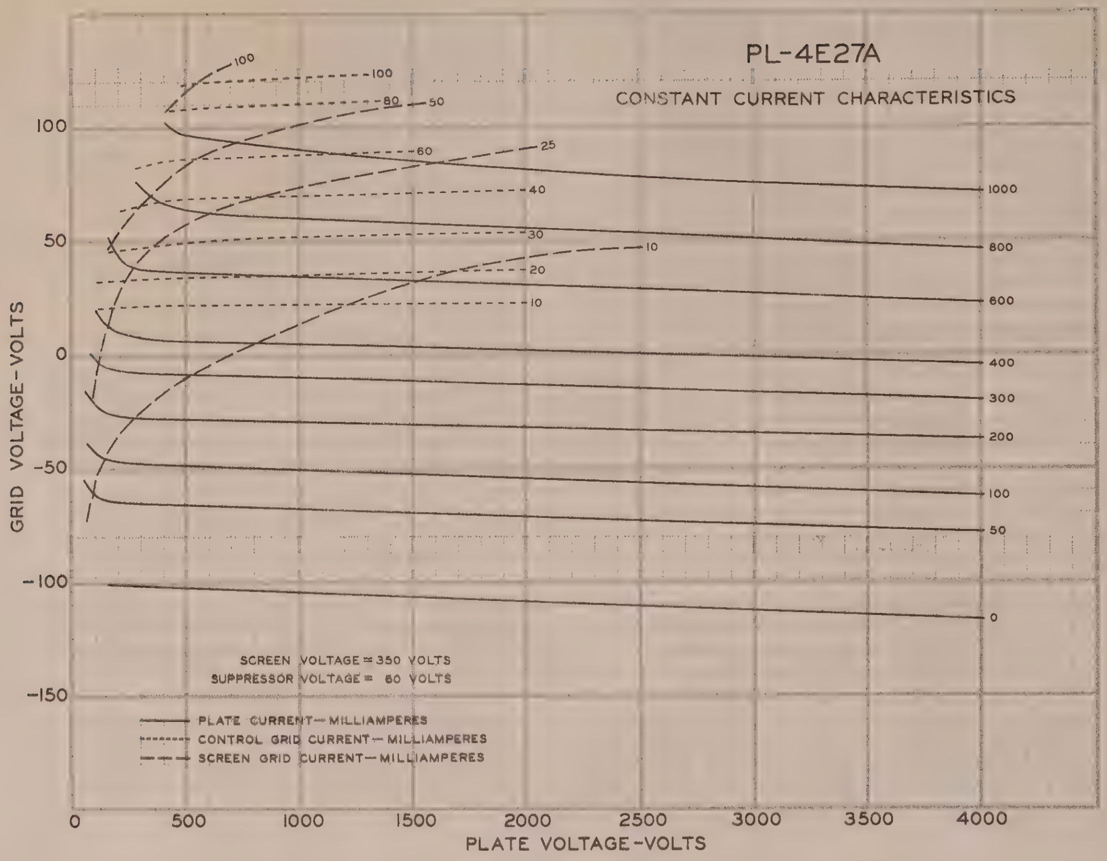
[3] Peak envelope power delivered to load from typical amplifier. So-called "plate power output" is approximately 10 per cent higher than values shown.

TYPICAL OPERATION — Class C C-W or FM Amplifier
Grounded-Cathode Circuit

D-C Plate Voltage	2000	2000	2500	2500	3000	3000	volts
D-C Screen-Grid Voltage	500	500	500	500	500	500	volts
D-C Suppressor-Grid Voltage	0	60	0	60	0	60	volts
D-C Control-Grid Voltage	-150	-150	-170	-170	-200	-200	volts
D-C Plate Current	185	220	190	222	163	187	ma.
D-C Screen-Grid Current	29	30	27	26	20	19	ma.
D-C Suppressor-Grid Current	0	6	0	5	0	5	ma.
D-C Control-Grid Current	8	10	8	10	6	7	ma.
Peak R-F Grid Voltage (approx.)	160	174	182	191	190	198	volts
Driving Power (approx.)	1.8	2.4	2.0	2.7	1.6	2.0	watts
Plate Power Input	370	440	475	555	490	560	watts
Plate Dissipation	125	125	130	130	130	125	watts
Useful Power Output[1]	225	285	285	375	325	405	watts

[1] Actual power output delivered to load from typical amplifier. So-called "plate power output" is approximately 10 per cent higher than values shown.

PL-4E27A


PL-4E27A
CONSTANT CURRENT CHARACTERISTICS
GRID VOLTAGE-VOLTS
100
50
0
-50
-100
-150
PLATE VOLTAGE-VOLTS
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500
1000
1500
2000
2500
3000
3500
4000
100
100
80
50
60
25
40
30
10
20
10
1000
800
600
400
300
200
100
50
0
SCREEN VOLTAGE = 350 VOLTS
SUPPRESSOR VOLTAGE = 60 VOLTS
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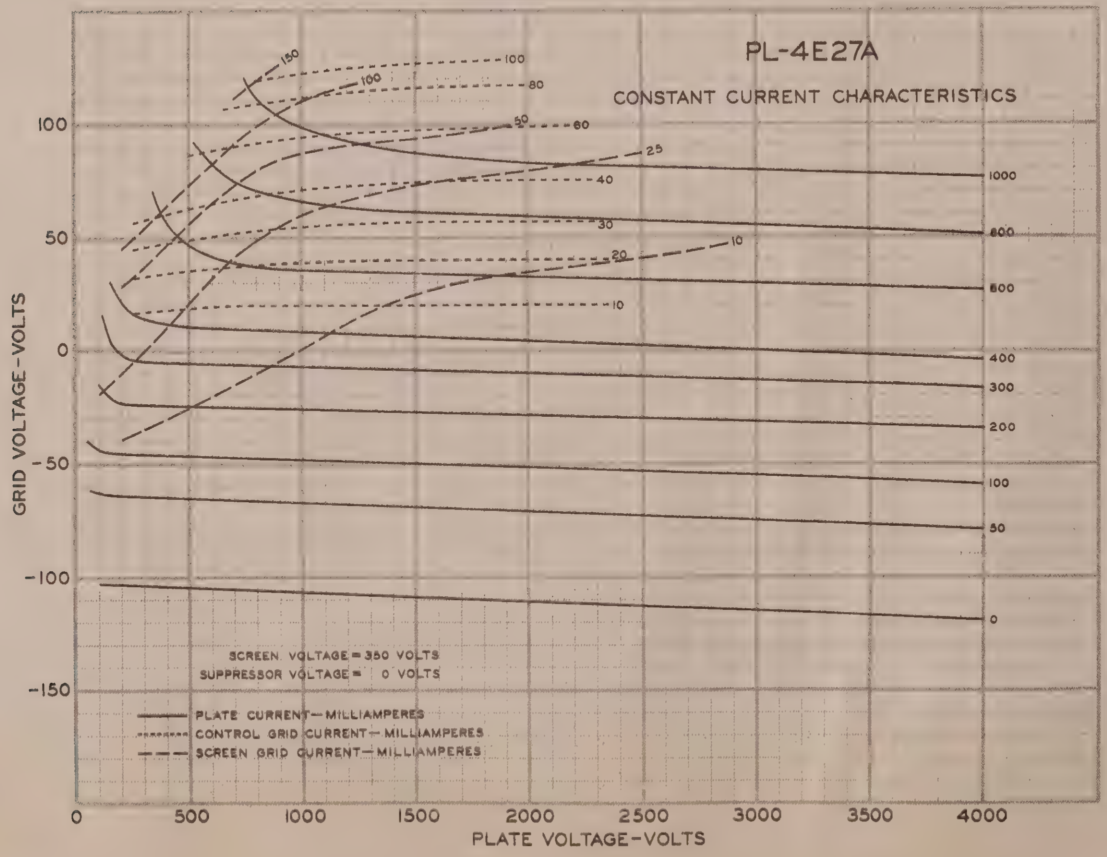
CONTROL GRID CURRENT—MILLIAMPERES
SCREEN GRID CURRENT—MILLIAMPERES


PL-4E27A
CONSTANT CURRENT CHARACTERISTICS
GRID VOLTAGE-VOLTS
100
50
0
-50
-100
-150
PLATE VOLTAGE-VOLTS
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500
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1500
2000
2500
3000
3500
4000
150
100
100
80
50
60
25
40
30
20
10
10
1000
800
600
400
300
200
100
50
0
SCREEN VOLTAGE = 350 VOLTS
SUPPRESSOR VOLTAGE = 0 VOLTS
PLATE CURRENT—MILLIAMPERES
CONTROL GRID CURRENT—MILLIAMPERES
SCREEN GRID CURRENT—MILLIAMPERES

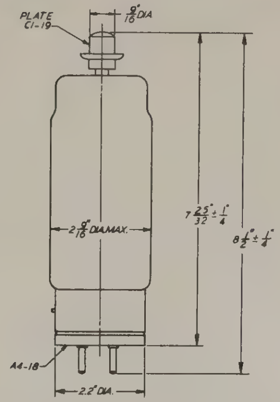
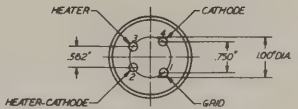


PLATE
C1-19
$\frac{9}{16}$" DIA
$7\frac{25}{32}" \pm \frac{1}{4}"$
$8\frac{1}{2}" \pm \frac{1}{4}"$
$2\frac{9}{16}$" DIA MAX.
A4-18
2.2" DIA.



SUPER JUMBO-4-PIN BASE

PL-5C22/
HT-415

HYDROGEN THYRATRON

The PL-5C22/HT415 is a low-jitter hydrogen thyratron designed for use in line-type radar modulators. A single PL-5C22/HT415 will provide a pulse power output of over 2 megawatts in pulse modulator service.

ELECTRICAL CHARACTERISTICS

Cathode --- Coated Unipotential

Heater Voltage	6.3 volts
Heater Current	10.5 amperes
Heating time (minimum)	5 minutes

Anode Ratings

Peak Forward Voltage	16.0 max. kv.
Peak Inverse Voltage	16.0 max. kv.[1]
D-C Supply Voltage	4.5 min. Kv.
Peak Current	325 max. amperes
Average Current	200 max. Ma.
Rate of Current Rise	1500 max. a/μs.
Time Jitter	.005 max. μsec.

The product of peak anode voltage, peak anode current and pulse repetition rate must not exceed 3.2 x 10^9.

Grid Drive Ratings[2]

Peak Positive Voltage	200 min. volts
Time of Rise (26 to 70 per cent)	0.5 max. μs.
Duration (70 per cent amplitude)	2.0 min. μs.
Peak Inverse Voltage	200 max. volts
Source Impedance	500 max. ohms

MECHANICAL CHARACTERISTICS

Mounting Position	Any[3]
Base	EIA A4-18
Basing	See base diagram

Maximum Overall Dimensions

Length	8.75 inches
Diameter	2.56 inches
Net Weight (approx.)	10 ounces

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[1] During the first 25 microseconds following the pulse, the peak inverse voltage must not be more than 5 kv. and must not be less than 5 per cent of the peak forward voltage.

[2] Measured at the tube socket with thyratron grid disconnected.

[3] Clamping permissible by the base or to bulb in the area up to 4-1/2 inches above top of the base.

Form 516R
July 20, 1959

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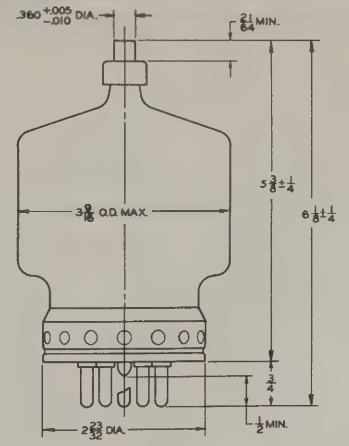

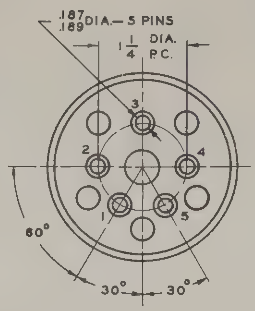

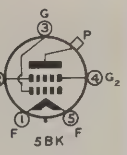

PL-5D22

(4-250A)

Power Tetrode

The Penta PL-5D22/4-250A is a power tetrode with a maximum plate dissipation rating of 250 watts. Cooling for normal operation is by radiation and by forced air cooling of five cubic feet per minute through the base. A radiator-type plate connector must be used for all classes of service at all frequencies. Forced cooling of the envelope and of the radiator-type plate connector, in addition to forced cooling of the base, is required for normal operation at frequencies above 30 Mc.

ELECTRICAL CHARACTERISTICS (Average)

Filament: Thoriated Tungsten

Voltage (± 5 per cent)	5.0	volts
Current	14.5	amperes
Grid-Screen mu factor	5.1	
Transconductance (2500 v. E_b, 500 v. E_{c2}, 100 ma. I_b)	4000	µmhos

Interelectrode Capacitances

Grid-Plate	0.12	µµf.
Input	12.7	µµf.
Output	4.5	µµf.
Maximum Frequency for Full Ratings	75	Mc.

MECHANICAL CHARACTERISTICS

Mounting Position—Vertical, base up or down

Base—5-pin metal shell

Basing—RTMA type 5BK

Maximum Overall Dimensions

Length	6.38	inches
Diameter	3.56	inches

Net Weight	8.0	ounces

Recommended Socket—Johnson 122-275, National HX-100, or equivalent.

January 20, 1959

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Form No. 509

COOLING

Forced-air cooling of the base and base seals of the PL-5D22/4-250A is required for all classes of operation. Such cooling normally is provided through use of a tube socket having holes which align with the holes in the tube base, and with a small fan or blower to pressurize the chassis upon which the tube is mounted. Alternatively, when an open chassis is used, a small fan or blower may be used with the outlet air stream directed at the tube socket. A minimum air flow of five cubic feet per minute through the base of the tube is required during the period that filament power is applied.

Adequate cooling of the envelope and plate seal for operation at frequencies below 30 Mc. can be obtained by convective air flow. Above 30 Mc. the air stream from a small fan or blower directed at the upper portion of the envelope normally will provide adequate cooling. In any event, the temperature of the plate cap should not be permitted to exceed 170°C for any class of continuous service.

RADIO-FREQUENCY OPERATION

The PL-5D22/4-250A is especially suited for use as a radio-frequency power amplifier. The compact construction and low interelectrode capacitances permit operation at full ratings at frequencies as high as 75 Mc. Operation at reduced ratings may be attained at frequencies as high as 120 Mc.

Under normal operating conditions, the PL-5D22/4-250A requires an unusually small amount of driving power for a specified value of plate power output. The high power sensitivity of the type permits a reduction in the power requirements imposed upon the preceding driver stage, but requires that adequate precautions be taken to minimize the feedback of energy from the output circuit back to the input circuit of the tube.

AUDIO-FREQUENCY OPERATION

The high power sensitivity of the PL-5D22/4-250A makes it well suited for use as an audio-frequency power amplifier or modulator in push-pull Class AB_1 or Class AB_2 service. In these classes of operation a pair of PL-5D22/4-250A's can give relatively high audio-frequency power output with low driving power and low harmonic distortion. Under Class AB_2 operating condition both grid bias and screen voltage must be obtained from a source having relatively good regulation. A series-connected string of voltage regulator tubes connected so as to regulate the output voltage of the screen-voltage supply normally will prove adequate. Grid bias voltage may be obtained from batteries or from a supply having a bleeder resistor of 250 ohms or less.

Under Class AB_1 operating conditions, the d-c screen voltage must be obtained from a supply having good regulation, but the internal impedance of the bias supply is not of critical importance. However, the effective grid circuit resistance per tube should not exceed 250,000 ohms.

MAXIMUM RATINGS—C C S (Continuous Commercial Service)

(Frequencies below 75 Mc.)	Class C FM or C.W.	Plate Mod. Class C	Class AB_1 Audio Ampl.	Class AB_2 Audio Ampl.	
D-C Plate Voltage	4000	3200	4000	4000	volts
D-C Screen Voltage	600	600	600	600	volts
D-C Grid Bias	—500	—500			volts
D-C Plate Current	350	275	350	350	ma.
Plate Dissipation	250	165	250	250	watts
Screen Dissipation	35	35	35	35	watts
Grid Dissipation	10	10	10	10	watts

TYPICAL OPERATION—Class C C-W or FM Amplifier

Frequencies below 75 Mc.

D-C Plate Voltage	2500	3000	4000	volts
D-C Screen Voltage	500	500	500	volts
D-C Grid Voltage	—150	—175	—225	volts
D-C Plate Current	300	333	313	ma.
D-C Screen Current	60	60	45	ma.
D-C Grid Current	9	9	9	ma.
Plate Dissipation	175	225	250	watts
Screen Dissipation	30	30	30	watts
Grid Dissipation	0.3	0.6	0.5	watts
Peak R-F Grid Voltage (approx.)	220	260	300	volts
Driving Power (approx.)	1.7	2.2	2.5	watts
Plate Power Input	750	1000	1250	watts
Plate Power Output	575	775	1000	watts

TYPICAL OPERATION—Class C Amplitude-Modulated Amplifier, Carrier Conditions

Frequencies below 75 Mc.

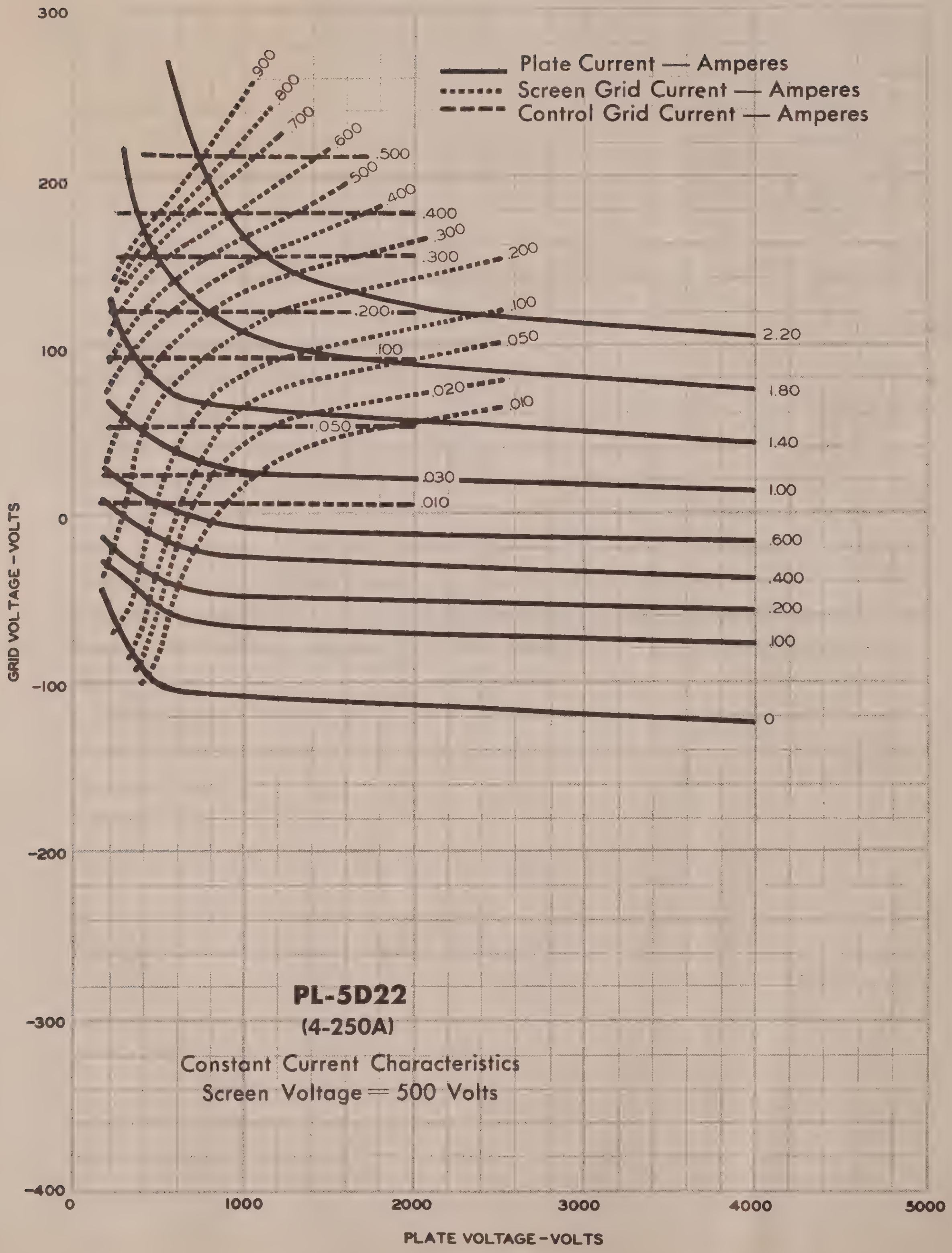
D-C Plate Voltage	2500	3000	volts
D-C Screen Voltage	400	400	volts
D-C Grid Voltage	—200	—310	volts
D-C Plate Current	200	225	ma.
D-C Screen Current	30	30	ma.
D-C Grid Current	9	9	ma.
Plate Dissipation	125	165	watts
Screen Dissipation	12	12	watts
Grid Dissipation	1.8	2.7	watts
Peak A-F Screen Voltage	350	350	volts
Peak R-F Grid Voltage (approx.)	250	360	volts
Driving Power (approx.)	2.1	3.1	watts
Plate Power Input	500	675	watts
Plate Power Output	375	510	watts

TYPICAL OPERATION—Class AB_1 A-F Power Amplifier or Modulator (Sine Wave, Two Tubes)

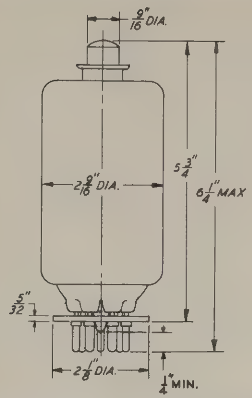
D-C Plate Voltage	2000	2500	3000	volts
D-C Screen Voltage	600	600	600	volts
D-C Grid Voltage	—105	—110	—115	volts
Zero-Sig. D-C Plate Current	110	120	120	ma.
Max.-Sig. D-C Plate Current	405	430	416	ma.
Zero-Sig. D-C Screen Current	—0.3	—0.3	—0.3	ma.
Max.-Sig. D-C Screen Current	22	13	11	ma.
Plate-to-Plate Load Resistance	9170	11,400	15,000	ohms
Peak A-F Grid-to-Grid Signal	175	180	186	volts
Driving Power	0	0	0	watts
Max.-Sig. Plate Dissipation (per tube)	175	225	250	watts
Max.-Sig. Plate Power Output	460	625	750	watts
Total Harmonic Distortion	2.5	2	2.5	pct.

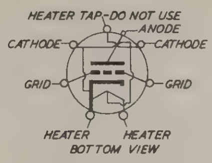
TYPICAL OPERATION—Class AB_2 A-F Power Amplifier or Modulator (Sine Wave, Two Tubes)

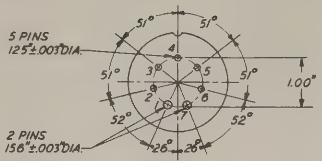
D-C Plate Voltage	2000	2500	3000	volts
D-C Screen Voltage	300	300	300	volts
D-C Grid Voltage	—48	—51	—53	volts
Zero-Sig. D-C Plate Current	120	120	123	ma.
Max.-Sig. D-C Plate Current	510	500	475	ma.
Zero-Sig. D-C Screen Current	0	0	0	ma.
Max.-Sig. D-C Screen Current	26	23	33	ma.
Plate-to-Plate Load Resistance	8000	11,000	16,000	ohms
Peak A-F Grid-to-Grid Signal	200	200	200	volts
Average Driving Power (Max. Sig.)	2.3	2.1	1.9	watts
Peak Driving Power (Max. Sig.)	5.5	4.8	4.6	watts
Max.-Sig. Plate Dissipation (per tube)	185	205	190	watts
Max.-Sig. Plate Power Output	650	840	1045	watts
Total Harmonic Distortion	4	4	4.6	pct.



PL-5D22
(4-250A)
Constant Current Characteristics
Screen Voltage = 500 Volts







PL-161

HYDROGEN THYRATRON

The PL-161 is a miniaturized low-jitter, pulse-service hydrogen thyratron having characteristics similar to those of the PL-5C22/HT415, but with reduced overall height. The PL-161 is more than two inches shorter than the PL-5C22/HT415, and will provide pulse power outputs of over 2 megawatts in typical line-type modulator service.

ELECTRICAL CHARACTERISTICS

Cathode --- Coated Unipotential

Heater Voltage	6.3 volts
Heater Current	10.5 amperes
Heating time (minimum)	5 minutes

Anode ratings

Peak Forward Voltage	16.0 max. kv.
Peak Inverse Voltage	16.0 max. kv.[1]
D-C Supply Voltage	3.5 min. Kv.
Peak Current	325 max. amperes
Average Current	200 max. Ma.
Rate of Current Rise	1500 max. a/µs.
Time Jitter	.005 max. µsec.

The product of peak anode voltage, peak anode current and pulse repetition rate must not exceed 3.2 x 10^9.

Grid Drive Ratings[2]

Peak Positive Voltage	200 min. volts
Time of Rise (26 to 70 per cent)	0.5 max. µs.
Duration (70 per cent amplitude)	2.0 min. µs.
Peak Inverse Voltage	200 max. volts
Source Impedance	500 max. ohms

MECHANICAL CHARACTERISTICS

Mounting Position	Any[3]
Base	7-pin with ceramic wafer[4]
Basing	See base diagram

Maximum Overall Dimensions

Length	6.25 inches
Diameter	2.56 inches

---

[1] During the first 25 microseconds following the pulse, the peak inverse voltage must not be more than 5 kv. and must not be less than 5 per cent of the peak forward voltage.

[2] Measured at the tube socket with the thyratron grid disconnected.

[3] Clamping, if any, should be to the ceramic wafer.

[4] Fits E. F. Johnson No. 122-237 socket, or equivalent.

Form 513
July 20, 1959

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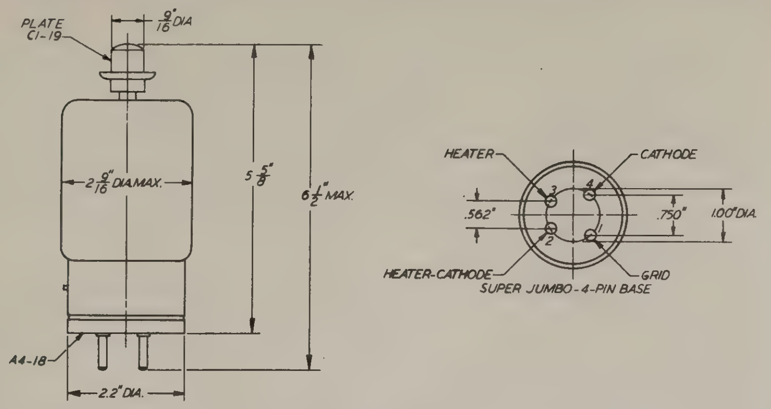


PL-165A

HYDROGEN THYRATRON

The PL-165A is a pulse-service hydrogen thyratron having external physical characteristics similar to those of the 4C35, but featuring electrical capabilities intermediate between those of the 4C35 and the 5C22/HT415. The PL-165A is particularly useful in applications where the capabilities of the 4C35 are exceeded, but where space is too limited to allow the use of the 5C22/HT415.

ELECTRICAL CHARACTERISTICS

Cathode --- Coated Unipotential

Heater Voltage	6.3 volts
Heater Current	7.8 amperes
Heating time (minimum)	5 minutes

Anode ratings

Peak Forward Voltage	12.0 max. kv.
Peak Inverse Voltage	12.0 max. kv.[1]
D-C Supply Voltage	3.5 min. Kv.
Peak Current	225 max. amperes
Average Current	150 max. Ma.
Rate of Current Rise	1000 max. a/μs.
Time Jitter	.005 max. μsec.

The product of peak anode voltage, peak anode current and pulse repetition rate must not exceed 2.4×10^9.

Grid Drive Ratings[2]

Peak Positive Voltage	200 min. volts
Time of Rise (26 to 70 per cent)	0.5 max. μs.
Duration (70 per cent amplitude)	2.0 min. μs.
Peak Inverse Voltage	200 max. volts
Source Impedance	500 max. ohms

MECHANICAL CHARACTERISTICS

Mounting Position	Any[3]
Base	EIA A4-18
Basing	See base diagram

Maximum Overall Dimensions

Length	6.50 inches
Diameter	2.56 inches

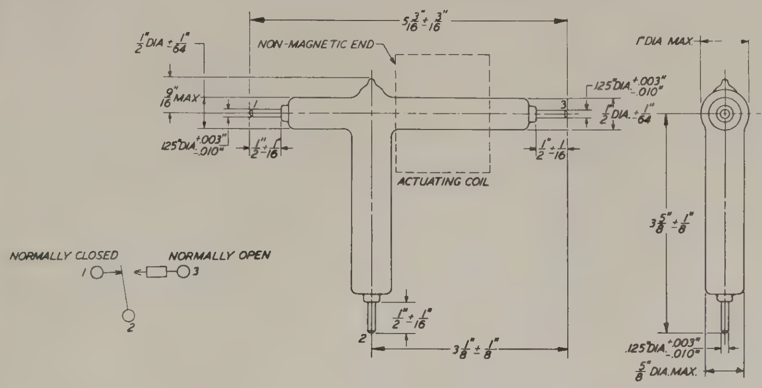
---

[1] During the first 25 microseconds following the pulse, the peak inverse voltage must not be more than 5 kv. and must not be less than 5 per cent of the peak forward voltage.

[2] Measured at the tube socket with the thyratron grid disconnected.

[3] Clamping permissible by base or to bulb in area up to 2 inches above top of the base.

Form 514R
July 20, 1959



PL-169A

Vacuum Switch

The Penta PL-169A is a single-pole double-throw switch enclosed in an evacuated glass envelope. This switch is particularly suited to high-voltage transfer applications, where a compact switch is required for transfer between circuits when current is not flowing, or for low-voltage switching applications in explosive atmospheres or where ambient pressure conditions make exposed-contact switches unsuitable.

The PL-169A is actuated by an external d-c solenoid, which must be located as shown in the drawing above.[1]

ELECTRICAL CHARACTERISTICS

Peak Voltage (between open contacts)	21,000 Max. Volts
Peak Current (pulses, 1 millisecond max. duration),	500 Max. Amps.
Average Current (250 volts, 60 cycles, a-c)	30 Max. Amps.
Operation with Recommended Coil:	
Coil Voltage (d-c)	24 Volts
Coil Current	560 Ma.

MECHANICAL CHARACTERISTICS

Mounting Position	Any
Terminal Arrangement	See Drawing
Maximum Overall Dimensions:	
Length	5.38 Inches
Width	4.31 Inches
Net Weight	3 Ounces

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[1] A suitable coil is type 179-55, manufactured by Waco, Inc., 2032 Broadway, Santa Monica, California.

January 20, 1959

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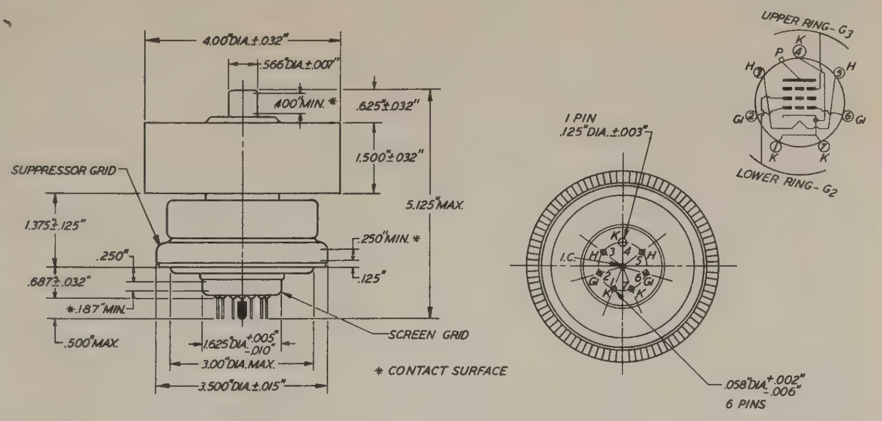
Form 521R



PL-172

Beam Pentode

DESCRIPTION

The PL-172 is a forced-air cooled, 1000-watt plate dissipation power pentode featuring high power gain and good efficiency at relatively low plate voltage. This tube is particularly well suited for low-distortion Class-AB$_1$ linear r-f amplifier service, where a single tube will deliver over 1500 watts of useful power output. The excellent characteristics of the PL-172 also provide outstanding performance in Class-AB$_2$, Class-B, and Class-C service.

ELECTRICAL CHARACTERISTICS

Cathode — Coated Unipotential	
Heater Voltage	6.0 volts
Heater Current	7.8 amperes
Minimum Cathode Heating Time	3 minutes
Grid-Screen mu Factor	3.4
Transconductance (1000 v. Eb, 500 v. Ec$_2$, 1 a. I$_b$)	23,000 μmhos
Interelectrode Capacitances	
Grid-Plate	0.09 μμf
Input	38 μμf
Output	18 μμf

MECHANICAL CHARACTERISTICS

Base	7-pin Septar, EIA E 7-2
Base Connections	See base diagram
Maximum Overall Dimensions	
Length	5.125 inches
Diameter	4.032 inches
Net Weight	3 pounds
Cooling	
Volume of air through cooler (at 1000 watts plate dissipation)	50 c.f.m., minimum
Pressure drop across cooler (at 50 c. f. m.)	0.15 in. water
Mounting Position	Axis vertical, base up or down, or horizontal with grid pins (No's. 2 and 6) in vertical plane.

March 15, 1960

PENTA LABORATORIES, INC.
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MOUNTING

The PL-172 may be mounted with the axis of the tube vertical, with the base up or down, or horizontally, with base pins 2 and 6 in a vertical plane. When the tube is mounted with the axis vertical, it should be supported by either the lower edge or the upper flat portion of the suppressor grid terminal ring or by the anode cooler. When mounted with the axis horizontal, the tube should be supported by the anode cooler. The PL-172 must not be supported by the glass or pins at the base.

Contact to the suppressor and screen grid contact surfaces should be made by spring contact material in at least three places around the periphery of each surface.

The base of the PL-172 fits a standard 7-pin Septar socket, such as the E. F. Johnson type 122-247 or 122-248, or National Co. type HX-29. The socket should be located so that the glass at the base of the tube does not contact the socket when the tube is seated in its support.

Special sockets having air-directing means, and contacts for all base pins and screen and suppressor grid terminals are available. The PL-184 socket has built-in by-pass capacitors for the screen grid and suppressor grid. The type PL-184A socket has a built-in by-pass capacitor for the screen grid, but grounded suppressor-grid contacts.

COOLING

Minimum anode cooling requirements for the PL-172, together with air flow vs. pressure drop data, are given by the graph below. A small amount of cooling air (approximately 5 c. f. m.) should be diverted over the base end of the tube from the anode cooling supply, either before or after entering the anode cooler, to limit the temperature of the base seals and the screen grid and suppressor grid contact surfaces to a maximum of 175° C.

The pressure drop graph below refers only to the drop through the cooler. If additional pressure losses occur in the air system between the blower and the cooler, such as might occur in a socket or air duct, these losses must be added to the figure taken from the curve to determine the static pressure which must be maintained at the blower.

OPERATION — GENERAL

Maximum ratings and typical operating conditions for the PL-172 are given in the accompanying tabular data.

Heater voltage for the PL-172 should be maintained as closely as possible to the rated value of 6.0 volts. Heater voltage variations up to 10 per cent are permissible, but decreased tube life and variations in power output may occur with prolonged operation at voltages more than 5 per cent from the rated value.

Screen-grid input in excess of the maximum rating can cause permanent damage to the PL-172. If screen voltage is obtained from a power supply separate from the plate voltage supply, the circuit should be arranged so that it is impossible to apply screen voltage without plate voltage. The use of a screen-grid overcurrent relay is recommended, to remove screen voltage immediately in case of excessive screen current due to circuit maladjustment, grid bias failure, or accidental removal of plate circuit loading.

In Class AB_1 or AB_2 applications, grid bias voltage for the PL-172 must be obtained from a fixed bias supply. The internal resistance of the bias source should not exceed 5000 ohms in Class AB_1 applications or 2000 ohms in Class AB_2 applications. Either fixed bias or cathode bias, or a combination of the two is recommended for Class C applications. Partial grid leak bias, in combination with fixed or cathode bias, or both, may be used in Class C application, if desired, provided the total resistance of the grid leak plus the bias source does not exceed 5000 ohms.

Excellent performance may be obtained from the PL-172 with the suppressor grid operated at cathode potential. For maximum efficiency at high power input at low plate voltages, a positive voltage of about 35 volts should be applied to the suppressor grid. The actual value of suppressor voltage is not critical, and voltages between 25 and 45 volts may be used with only minor differences in performance. The internal resistance of the suppressor-grid voltage supply should not exceed 3000 ohms.

RADIO-FREQUENCY OPERATION

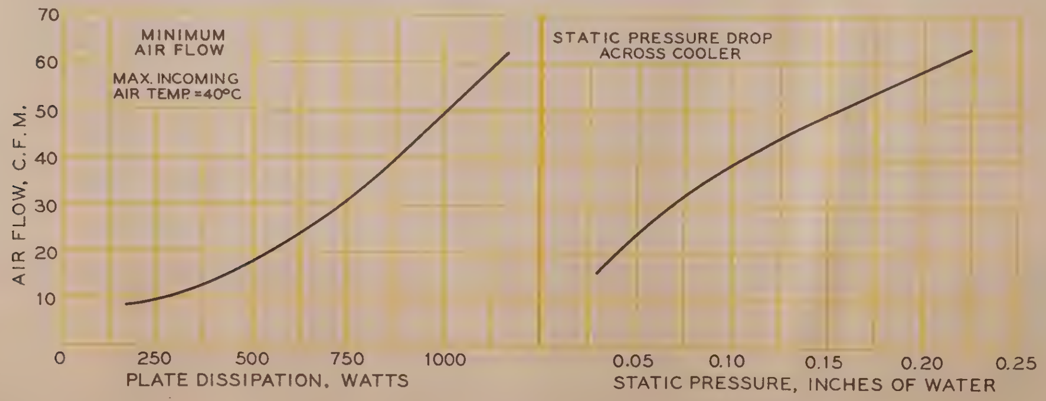
In most ordinary Class-C applications, the PL-172 may be operated without neutralization, provided the suppressor and screen grids are effectively grounded for radio frequencies. In low-distortion Class AB_1 linear amplifier service, where reaction on the driver circuit must be entirely eliminated, it will usually be found advisable to neutralize the small feedback capacitance of the PL-172.

A metal chassis or equivalent means should be provided to separate the input and output circuits of an amplifier employing the PL-172. Reasonable precautions should be observed in regard to by-passing and shielding of the supply leads to prevent coupling between input and output through external circuits.

When it is desired to apply voltage to the suppressor grid of the PL-172, it is recommended that the suppressor grid by-pass capacitor or capacitors be located on the anode side of the chassis. The total suppressor-grid by-pass capacitance should be sufficient to result in a reactance of 3 ohms or less at the operating frequency. The d-c supply lead to the suppressor grid should either be located entirely on the anode side of the shielding, or fed through an effective r-f choke located well out of the field on the plate tank circuit and again by-passed before passing through the shielding into any compartment exposed to the control grid circuit.

For Class-AB_1 linear amplifier service, the screen voltage for the PL-172 must be obtained from a well regulated source, to prevent excessive screen voltage variations due to the changes in screen current which occur between zero-signal and full-signal conditions.

The tabulated suggested Class AB_1 linear r-f amplifier operating conditions given on page three result in third-order distortion products approximately 25 db below peak envelope power output, without the use of degenerative r-f feedback. Reduced grid bias voltage and correspondingly higher zero-signal plate and screen current will reduce distortion at the expense of a reduction in efficiency.



PL–172 AIR COOLING CHARACTERISTICS

MAXIMUM RATINGS

CCS (Continuous Commercial Service)

	Class-C CW or FM	*Class-AB_2 Audio or RF*	*Class-AB_1 Audio or RF*	
D-C Plate Voltage	3000	3000	3000	volts
D-C Screen-Grid Voltage	500	500	600	volts
D-C Suppressor-Grid Voltage	75	75	75	volts
D-C Control-Grid Voltage	–200			volts
D-C Plate Current	1000	800	800	ma.
D-C Control-Grid Current	10	10		ma.
Control-Grid Dissipation	5	5		watts
Screen-Grid Input	30	30	30	watts
Plate Dissipation	1000	1000	1000	watts

TYPICAL OPERATION — Class AB_1 Linear R-F Amplifier[1]

Single-Sideband, Suppressed Carrier

Grounded Cathode Circuit

D-C Plate Voltage	2000	2500	2500	3000	volts
D-C Screen-Grid Voltage	500	500	500	500	volts
D-C Suppressor-Grid Voltage	35	0	35	35	volts
D-C Control-Grid Voltage[2]	–110	–115	–115	–115	volts
Zero-Signal D-C Plate Current	200	200	200	220	ma.
Zero-Signal D-C Screen Current	12	11	11	11	ma.
Maximum-Signal D-C Plate Current	800	800	800	800	ma.
Maximum-Signal D-C Screen Current	43	50	40	39	ma.
Maximum-Signal Peak R-F Grid Voltage	110	115	115	115	volts
Maximum-Signal Power Input	1600	2000	2000	2400	watts
Maximum-Signal Useful Power Output[3]	1040	1140	1260	1590	watts

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[1] D-C current values shown are for peak conditions, or for single-tone modulation at full signal.
[2] Approximate value; adjust to give stated zero-signal plate current.
[3] Peak envelope power delivered to load from typical amplifier.

TYPICAL OPERATION — Class C C-W or FM Amplifier

Grounded-Cathode Circuit

D-C Plate Voltage	2000	2500	3000	volts
D-C Screen-Grid Voltage	500	500	500	volts
D-C Suppressor-Grid Voltage	35	35	35	volts
D-C Control-Grid Voltage	–175	–200	–200	volts
D-C Plate Current	850	840	820	ma.
D-C Screen-Grid Current	42	40	42	ma.
D-C Control-Grid Current	10	10	10	ma.
Peak R-F Grid Voltage (Approx.)	188	210	210	volts
Driving Power (Approx.)	1.9	2.1	2.1	watts
Plate Power Input	1700	2100	2460	watts
Useful Power Output[1]	1155	1440	1770	watts

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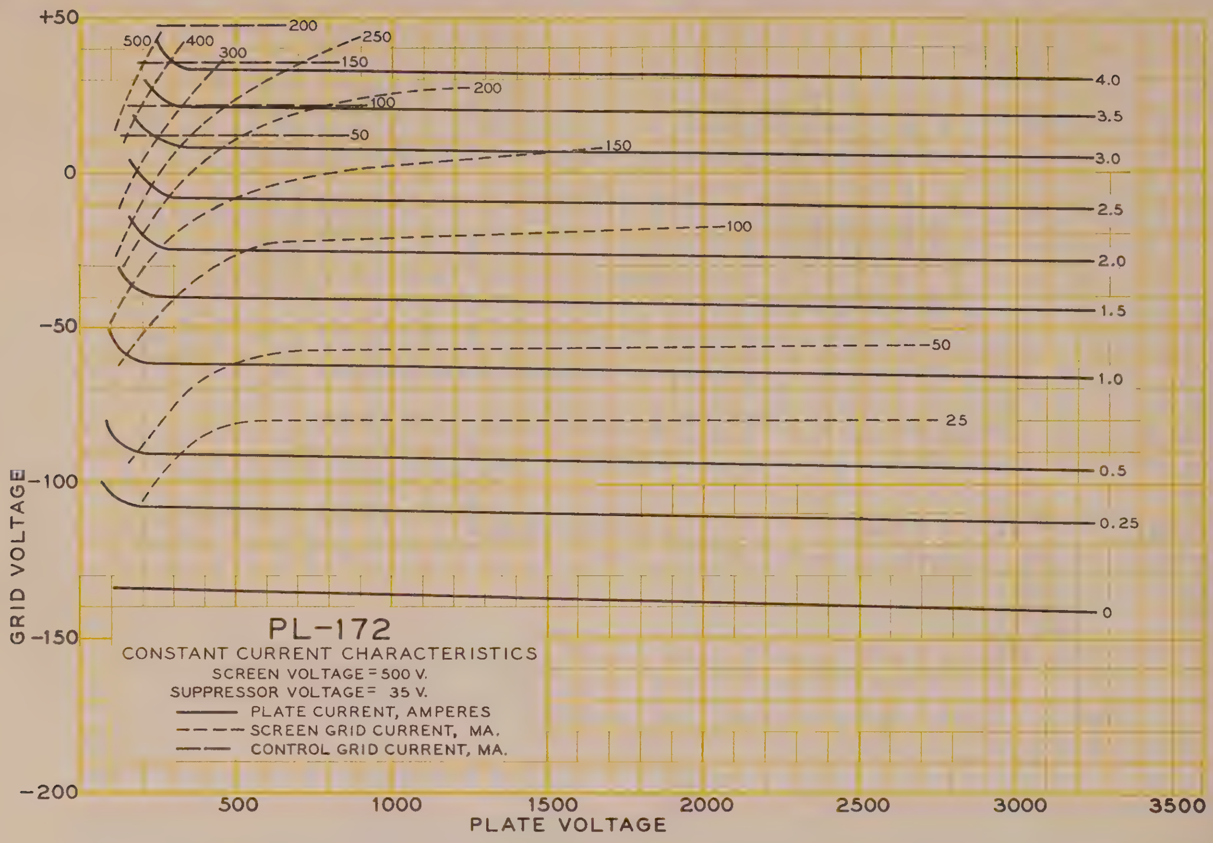
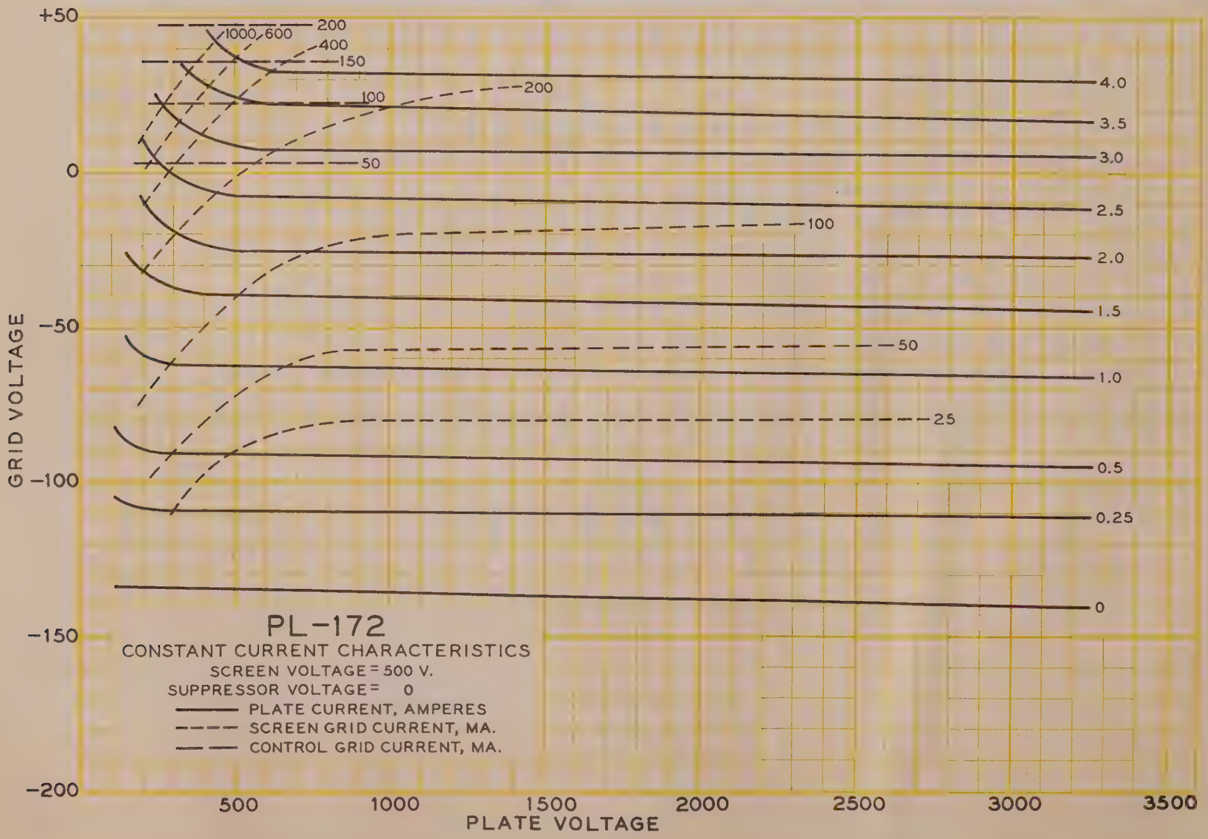
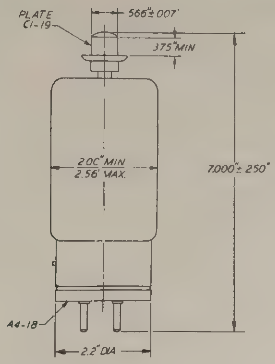
[1] Actual power output delivered to load from typical amplifier.

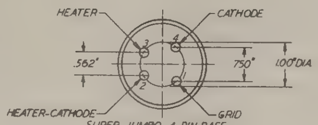


PL-172
CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE = 500 V.
SUPPRESSOR VOLTAGE = 35 V.
——— PLATE CURRENT, AMPERES
– – – – SCREEN GRID CURRENT, MA.
— — — CONTROL GRID CURRENT, MA.



PL-172
CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE = 500 V.
SUPPRESSOR VOLTAGE = 0
——— PLATE CURRENT, AMPERES
– – – – SCREEN GRID CURRENT, MA.
— — — CONTROL GRID CURRENT, MA.





SUPER JUMBO-4-PIN BASE

PL-174
(6587)

HYDROGEN THYRATRON

The PL-174 is a miniaturized low-jitter, pulse-service hydrogen thyratron having characteristics similar to those of the PL-5C22/HT415, but with reduced overall height. The PL-174 will provide a pulse power output of over 2 megawatts in typical line-type modulator service.

ELECTRICAL CHARACTERISTICS

Cathode -- Coated Unipotential

Voltage	6.3 volts
Current	10.5 amperes
Heating time (Minimum)	3 minutes

Anode Ratings

Peak Forward Voltage	16.0 max. kv.
Peak Inverse Voltage	16.0 max. kv.[1]
D-C Supply Voltage	3.5 min. kv.
Peak Current	325 max. amperes
Average Current	225 max. ma.
Rate of Current Rise	1500 max. a/us.
Time Jitter	.005 max. usec.

The product of peak anode voltage, peak anode current and pulse repetition rate must not exceed 3.9×10^9.

Grid Drive Ratings[2]

Peak Positive Voltage	200 min. volts
Time of Rise (26 to 70 per cent)	0.5 max. us.
Duration (70 per cent amplitude)	2.0 min. us.
Peak Inverse Voltage	200 max. volts
Source Impedance	500 max. ohms

MECHANICAL CHARACTERISTICS

Mounting Position	Any[3]
Base	EIA A-4-18
Basing	See base diagram
Maximum Overall Dimensions	
Length	7.25 inches
Diameter	2.56 inches

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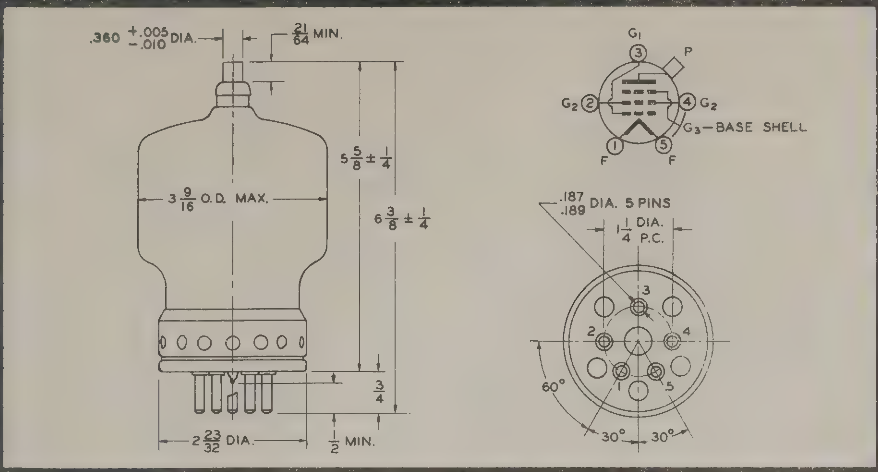
[1] During the first 25 microseconds following the pulse, the peak inverse voltage must not be more than 5 kv.
[2] Measured at the tube socket with the thyratron grid disconnected.
[3] Clamping permissible by base or to bulb in area up to 2 inches above top of the base.

Form 533
October 31, 1958

PENTA LABORATORIES, INC.
312 NORTH NOPAL STREET • SANTA BARBARA, CALIFORNIA



PL-175A

Beam Pentode

The PL-175A is a 400-watt plate dissipation beam pentode which incorporates the exclusive Penta vane-type suppressor grid. In most cases, the tube may be used to replace directly the 4-400A, with no circuit modifications, and only slight readjustment of tuning controls. In Class AB_1 amplifier applications, such replacement can result in 20% to 40% greater output. The suppressor grid terminates in the tube base shell, and is designed to be operated at zero voltage. The base shell must be grounded to the chassis by means of suitable spring clips.

ELECTRICAL CHARACTERISTICS

Filament -- Thoriated Tungsten	
Voltage	5.0 volts
Current	14.5 amperes
Grid-Screen Amplification Factor	4.5
Interelectrode Capacitances	
Grid-Plate	0.06 $\mu\mu$fd.
Input	15.1 $\mu\mu$fd.
Output	9.8 $\mu\mu$fd.

MECHANICAL CHARACTERISTICS

Base	5-pin, metal shell
Maximum Overall Dimensions	
Length	6.63 inches
Diameter	3.56 inches

MAXIMUM RATINGS – CCS (Continuous Commercial Service)

	Class-AB_1 R-F or Audio	Class-C CW or FM	
D-C Plate Voltage	4000	4000	max. volts
D-C Screen Voltage	1000	600	max. volts
D-C Suppressor-Grid Voltage	100	100	max. volts
D-C Plate Current	350	350	max. ma
Screen-Grid Input	25	25	max. watts
Plate Dissipation	400	400	max. watts

1 June 1960

PENTA LABORATORIES, INC.
312 NORTH NOPAL STREET • SANTA BARBARA, CALIFORNIA

TYPICAL OPERATION — Class C C-W or FM Amplifier
Grounded-Cathode Circuit

D-C Plate Voltage	2000	2000	2500	2500	3000	3000	4000	4000	volts
D-C Screen-Grid Voltage	500	600	500	600	500	600	500	600	volts
D-C Suppressor-Grid Voltage	0	0	0	0	0	0	0	0	volts
D-C Control-Grid Voltage	-160	-180	-160	-180	-160	-180	-180	-200	volts
D-C Plate Current	350	350	350	350	350	350	350	350	ma
D-C Screen-Grid Current	46	42	41	40	38	36	34	29	ma
D-C Control-Grid Current	14	8	12	7	11	6	10	6	ma
Peak R-F Control-Grid Voltage	226	226	218	226	214	218	236	239	volts
Driving Power (approx.)	3.1	1.8	2.6	1.6	2.4	1.3	2.4	1.4	watts
Plate Power Input	700	700	875	875	1050	1050	1400	1400	watts
Plate Dissipation (approx.)	200	190	230	220	275	265	360	345	watts
Useful Power Output[1]	460	470	590	600	705	715	945	960	watts

TYPICAL OPERATION[2] — Class AB$_1$ Linear R-F Amplifier
Single-Sideband, Suppressed Carrier
Grounded Cathode Circuit

D-C Plate Voltage	2000	2500	3000	3500	volts
D-C Screen-Grid Voltage	750	750	750	750	ma
D-C Suppressor-Grid Voltage	0	0	0	0	volts
D-C Control-Grid Voltage[3]	-135	-143	-150	-160	volts
Zero-Signal D-C Plate Current	125	100	80	75	ma
Zero-Signal D-C Screen Current	3	1	1	1	ma
Maximum-Signal D-C Plate Current	350	350	350	350	ma
Maximum-Signal D-C Screen Current	37	35	29	24	ma
Maximum-Signal Peak R-F Grid Voltage	135	143	150	160	volts
Maximum-Signal Plate Power Input	700	875	1050	1225	watts
Maximum-Signal Plate Dissipation (approx.)	225	265	305	345	watts
Maximum-Signal Useful Power Output[1]	445	570	680	790	watts

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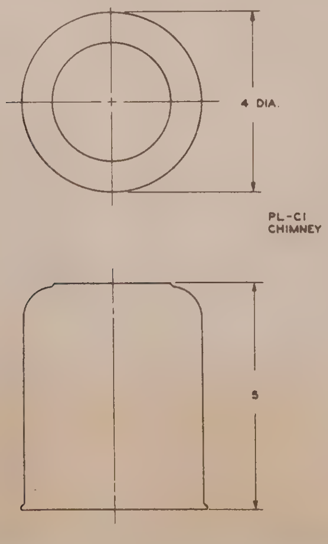
[1] Actual useful power delivered to load from typical amplifier. So-called "plate power output" is approximately 10 per cent higher than values shown.

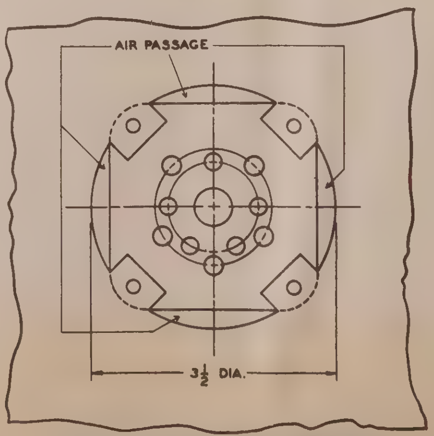
[2] D-C Current values shown are for peak conditions, or for single-tone modulation at full signal.

[3] Approximate value; adjust to give stated zero-signal plate current.

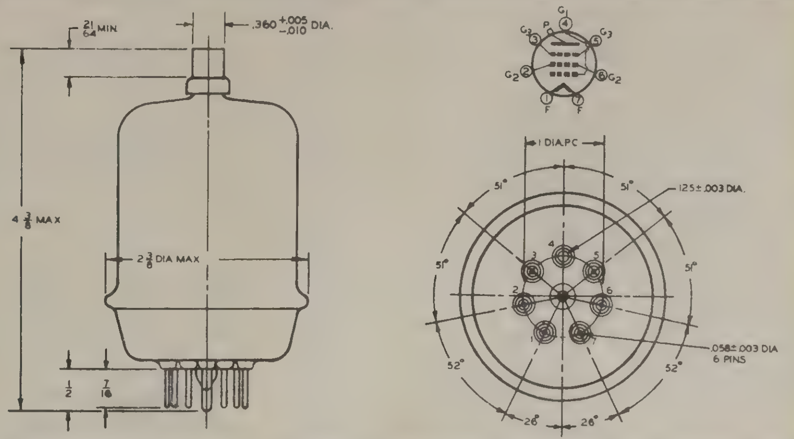
COOLING- Forced air cooling of the seals at the base end of the PL-175A is required in all classes of service. A flow of 5 c. f. m. of cooling air should be passed through the base. Adequate envelope cooling at 400 watts plate dissipation requires 15 c. f. m. of cooling air past the envelope and across the plate seal. Proper distribution of cooling air may be obtained by the use of a type PL-C1 glass chimney, with chassis cut out as shown below.



PL-C1 CHIMNEY



CHASSIS CUT-OUT AND SOCKET MOUNTING FOR PROPER AIR DISTRIBUTION FROM PRESSURIZED CHASSIS (JOHNSON NO. 122-275 SOCKET)



PL-177A

Beam Pentode

The PL-177A is a 75-watt radiation-cooled beam pentode incorporating a vane-type suppressor grid, to allow optimum performance with zero suppressor-grid voltage in many applications. Outstanding features of the PL-177A are its capabilities for high power output at relatively low plate voltage and low distortion as a linear r-f or audio amplifier.

ELECTRICAL CHARACTERISTICS

Filament -- Thoriated Tungsten	
Voltage	6.0 volts
Current	3.2 amperes
Grid-Screen Amplification Factor	5
Interelectrode Capacitances	
Grid-Plate	0.06 μμfd.
Input	7.5 μμfd.
Output	4.2 μμfd.
Transconductance (500 v. Eb, 400 v. Ec2, 150 ma. Ib)	4500 μmhos

MECHANICAL CHARACTERISTICS

Base[1]	7-pin Septar, EIA E7-2
Maximum Overall Dimensions	
Length	4.38 inches
Diameter	2.38 inches

MAXIMUM RATINGS – CCS (Continuous Commercial Service)

(Frequencies up to 175 Mc.)	Class AB1 R-F or Audio	Class C CW or FM	
D-C Plate Voltage	2000	2000	max. volts
D-C Screen-Grid Voltage	600	600	max. volts
D-C Suppressor-Grid Voltage	100	100	max. volts
D-C Plate Current	175	150	max. ma.
Screen-Grid Input	10	10	max. watts
Plate Dissipation	75	75	max. watts

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[1] Fits Johnson No. 122-101 or 122-247 or National No. HX-29 sockets.

15 September 1960

PENTA LABORATORIES, INC.
312 NORTH NOPAL STREET • SANTA BARBARA, CALIFORNIA

Form 505

TYPICAL OPERATION — Class C C-W or FM Amplifier
Grounded-Cathode Circuit

D-C Plate Voltage	600	750	1000	1500	2000 volts
D-C Screen-Grid Voltage	400	400	400	400	400 volts
D-C Suppressor-Grid Voltage	0	0	0	0	0
D-C Control-Grid Voltage	-90	-90	-105	-115	-125 volts
D-C Plate Current	150	150	150	150	150 ma.
D-C Screen-Grid Current	18	17	16	14	12 ma.
D-C Control-Grid Current	6	6	5	5	5 ma.
Peak R-F Grid Voltage (approx.)	130	125	140	155	165 volts
Driving Power (approx.)	0.75	0.75	0.70	0.75	0.80 watts
Screen-Grid Power Input	7.2	6.8	6.8	6.4	4.8 watts
Plate Power Input	90	112	150	225	300 watts
Plate Dissipation	30	38	40	45	50 watts
Useful Power Output[2]	55	66	100	160	220 watts

TYPICAL OPERATION — Class AB$_1$ Linear R-F Amplifier[3]
Single-Sideband, Suppressed Carrier
Grounded Cathode Circuit
(Intermittent Modulation)

D-C Plate Voltage	1000	1500	2000 volts
D-C Screen-Grid Voltage	600	600	600 volts
D-C Suppressor-Grid Voltage	0	0	0
D-C Control-Grid Voltage[4]	-98	-110	-115 volts
Zero-Signal D-C Plate Current	40	30	25 ma.
Zero-Signal D-C Screen Current	0	0	0
Maximum-Signal D-C Plate Current	175	175	175 ma.
Maximum-Signal D-C Screen Current	10	8	7 ma.
Maximum-Signal Peak R-F Grid Voltage	96	108	112 volts
Maximum-Signal Plate Power Input	175	262	350 watts
Maximum-Signal Plate Dissipation[5]	70	110	125 watts
Maximum-Signal Useful Power Output[2]	96	140	210 watts

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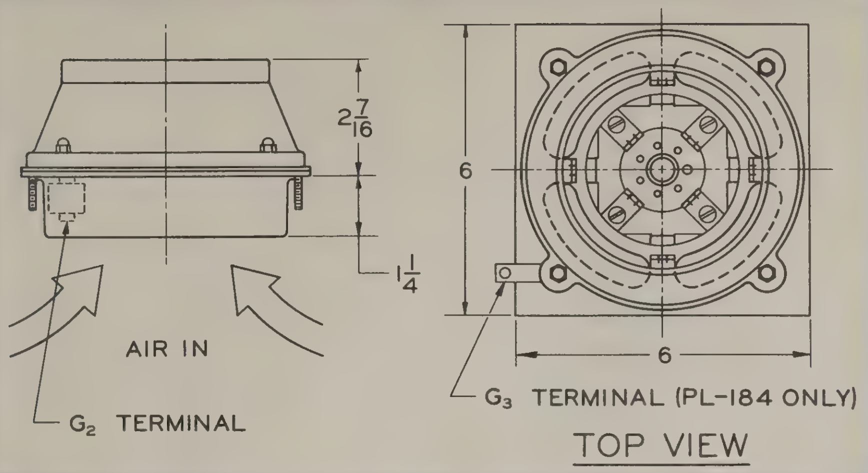
[2] Actual useful power output delivered to load from typical amplifier. So-called "plate power output" is approximately 10 per cent higher, and is equal to difference between power input and plate dissipation.

[3] D-C current and power values shown are for peak conditions, or for single-tone modulation at full signal.

[4] Approximate value; adjust to give stated zero-signal plate current.

[5] Plate dissipation values shown for information only. During normal operation with intermittent modulation, average plate dissipation will not exceed 75-watt maximum rating.



PL-184
and
PL-184A

Sockets for Type PL-172 Beam Pentode

The PL-184 and PL-184A sockets provide electrical connections and air-flow directing means for the PL-172 beam pentode. The socket includes contact provisions for all base pins and the screen-grid and suppressor-grid ring terminals.

Proper use of the socket requires that it be mounted in an aperture in a pressurized chamber, such as a chassis. The drawing on the opposite side of this sheet gives dimensions of the chassis cut-out necessary to accommodate the socket. Proper cooling of the PL-172 will be obtained with a static pressure within the chassis equal to 0.28 inches of water. Suitable precautions should be taken to ascertain that cooling air is delivered uniformly to the bottom of the socket, to prevent non-uniform air flow through the socket and tube.

Radio-frequency by-pass capacitors for the screen grid are built into the PL-184 and PL-184A sockets. The PL-184 also has a built-in suppressor grid radio-frequency by-pass capacitor. The suppressor grid contacts are grounded on the PL-184A socket.

ELECTRICAL DATA

	PL-184	PL-184A
Screen-grid By-Pass Capacitance	2000 µµfd.	2000 µµfd.
Suppressor-grid By-Pass Capacitance	1500 µµfd. *	grounded

MECHANICAL DATA

Maximum Overall Dimensions	6 x 6 x 3-11/16 inches
Weight	2 pounds

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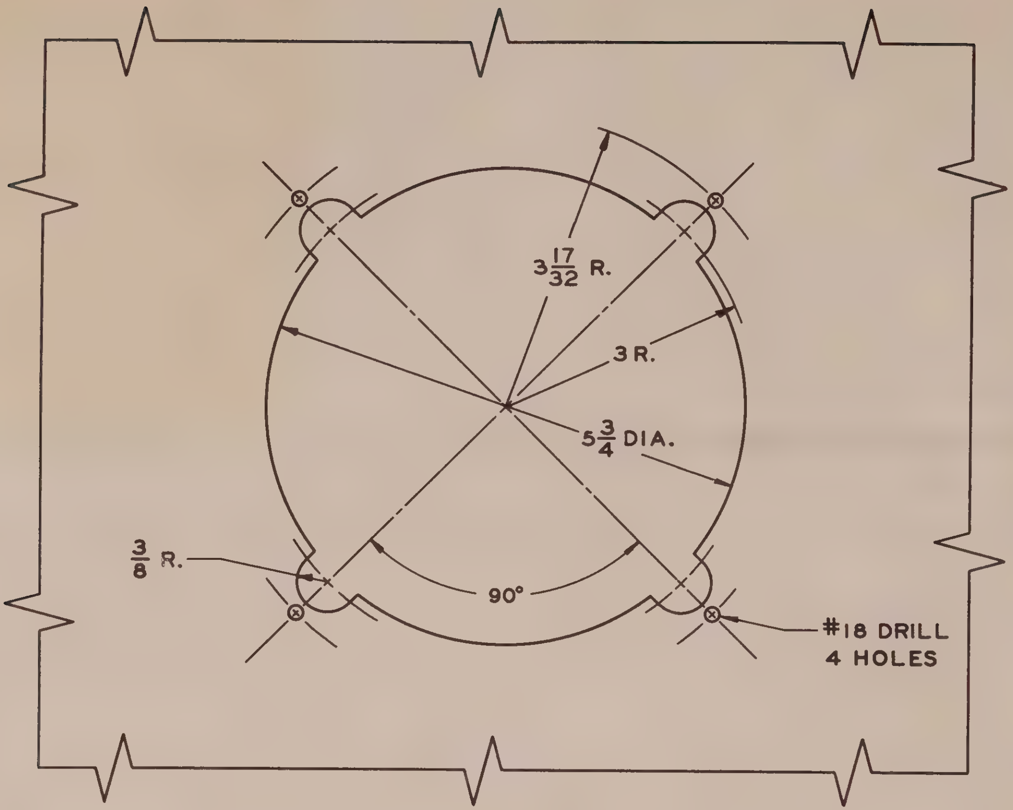
* Supplementary suppressor-grid by-pass capacitance, by means of fixed mica capacitor, desirable at frequencies below 30 Mc.

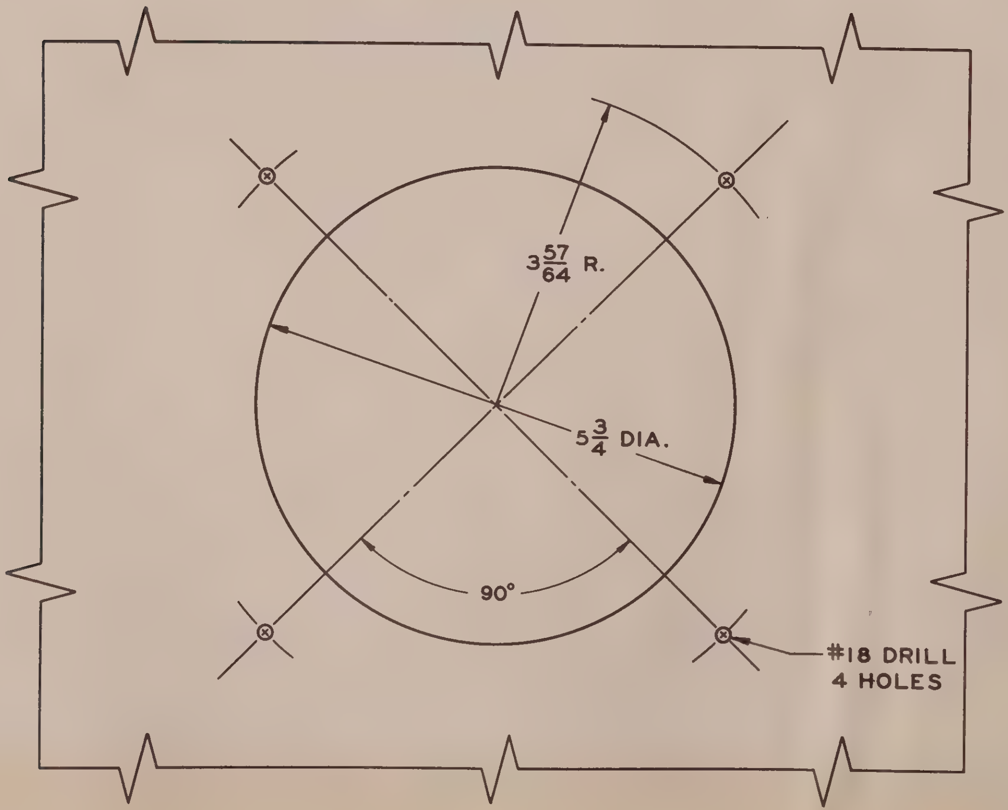
April 15, 1959

PENTA LABORATORIES, INC.
312 NORTH NOPAL STREET • SANTA BARBARA, CALIFORNIA

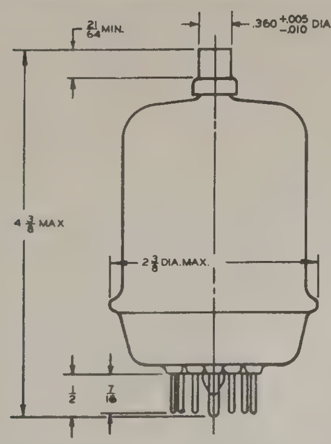
Form 518R

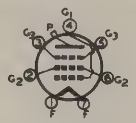


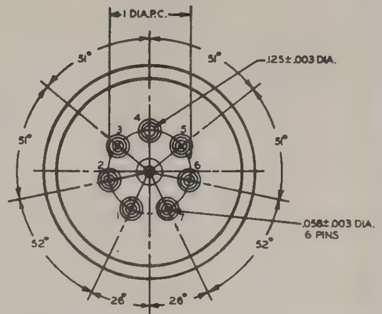
CHASSIS CUTOUT FOR PL-184



CHASSIS CUTOUT FOR PL-184A







PL-6549

Beam Pentode

DESCRIPTION

The Penta PL-6549 is a 75-watt dissipation aligned-grid pentode featuring good performance at low plate voltage, but also capable of good performance at relatively high voltage, for medium-power applications. The improved current-division characteristics resulting from the use of a suppressor grid permit the use of screen voltages approaching the plate voltage in low power applications. This feature of the PL-6549 results in excellent power gain and output characteristics, both as an audio and radio-frequency amplifier.

ELECTRICAL CHARACTERISTICS

FOR REPLACEMENT USE ONLY

USE PL-177A FOR NEW EQUIPMENT

Filament — Thoriated Tungsten (Quick Heating)	
Voltage	6.0 volts
Current	3.3 amperes
Grid-Screen mu Factor	5.0
Transconductance (500 v. E_b, 400 v. Ec_2, 0 v. Ec_3, 150 ma. I_b)	4500 μmhos
Interelectrode Capacitances	
Grid-Plate	0.09 μμf
Input	7.5 μμf
Output	3.4 μμf

MECHANICAL CHARACTERISTICS

Base[1]	7-pin Septar, EIA E 7-2
Basing	See base diagram
Maximum Overall Dimensions	
Length	4.38 inches
Diameter	2.38 inches
Mounting Position — Vertical, base up or down	

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[1] Fits Johnson No. 122-101 or 122-247 or National No. HX-29 sockets.

Form 506
1 July 1960

PENTA LABORATORIES, INC.

312 NORTH NOPAL STREET • SANTA BARBARA, CALIFORNIA

PL-6549

MAXIMUM RATINGS — C C S (Continuous Commercial Service)

(Frequencies below 175 Mc.)	Class-C FM or CW	Class-C Plate Mod.	Class AB$_1$ Audio Ampl.	Class AB$_2$ Audio Ampl.	
D-C Plate Voltage	2000	2000	2000	2000	volts
D-C Screen-Grid Voltage	600	600	600	600	volts
D-C Suppressor-Grid Voltage	100	100	100	100	volts
D-C Plate Current	150	125	175	175	ma.
Plate Dissipation	75	50	75	75	watts
Screen-Grid Input	10	10	10	10	watts

TYPICAL OPERATION — Class-C CW or FM Amplifier

Frequencies below 175 Mc.

D-C Plate Voltage	600	750	1000	1500	2000	volts
D-C Screen-Grid Voltage	400	400	400	400	400	volts
D-C Suppressor-Grid Voltage	70	70	70	70	70	volts
D-C Control-Grid Voltage	—90	—90	—105	—115	—125	volts
D-C Plate Current	150	150	150	150	150	ma.
D-C Screen-Grid Current	18	17	16	14	12	ma.
D-C Suppressor-Grid Current	7	6.5	5.5	5	5	ma.
D-C Control-Grid Current	6	6	5	5	5	ma.
Peak R-F Grid Voltage (approx.)	130	125	140	155	165	volts
Driving Power (approx.)	0.75	0.75	0.70	0.75	0.80	watts
Screen-Grid Power Input	7.2	6.8	6.8	6.4	4.8	watts
Plate Power Input	90	112	150	225	300	watts
Plate Dissipation	30	38	40	45	50	watts
Plate Power Output	60	74	110	180	250	watts

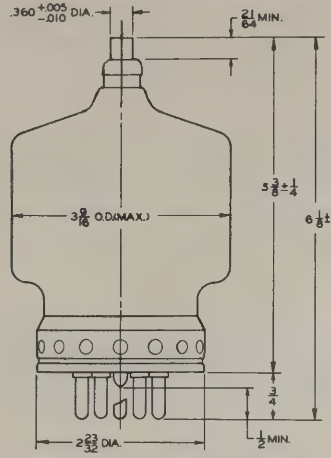
TYPICAL OPERATION — Class-AB$_1$ A.F. Power Amplifier or Modulator (Sine Wave, Two Tubes)

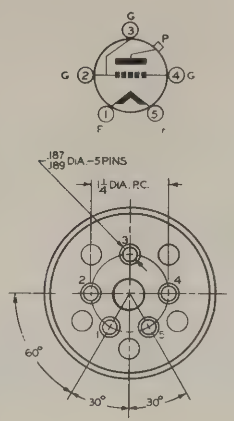
D-C Plate Voltage	600	1000	1500	2000	volts
D-C Screen-Grid Voltage	600	600	600	600	volts
D-C Suppressor-Grid Voltage	70	70	70	70	volts
D-C Control-Grid Voltage*	—100	—108	—115	—120	volts
Zero-Sig. D-C Plate Current	70	50	40	30	ma.
Max.-Sig. D-C Plate Current	350	320	240	210	ma.
Zero-Sig. D-C Screen-Grid Current	1.5	0.5	0.3	0.1	ma.
Max.-Sig. D-C Screen-Grid Current	28	20	14	9	ma.
Peak A-F Grid-to-Grid Voltage	195	200	180	170	volts
Plate-to-Plate Load Resistance	2550	5800	11,700	19,800	ohms
Max.-Sig. Plate Dissipation (per tube)	59	68	73	73	watts
Max.-Sig. Plate Power Output	92	185	220	275	watts

TYPICAL OPERATION — Class-AB$_2$ A.F. Power Amplifier or Modulator (Sine Wave, Two Tubes)

D-C Plate Voltage	600	1000	1500	2000	volts
D-C Screen-Grid Voltage	400	400	400	400	volts
D-C Suppressor-Grid Voltage	70	70	70	70	volts
D-C Control-Grid Voltage*	—65	—72	—78	—85	volts
Zero-Sig. D-C Plate Current	70	50	40	30	ma.
Max.-Sig. D-C Plate Current	350	350	285	225	ma.
Zero-Sig. D-C Screen-Grid Current	1.4	0.5	0.2	0.1	ma.
Max.-Sig. D-C Screen-Grid Current	40	34	18	10	ma.
Peak A-F Grid-to-Grid Voltage	210	230	190	180	volts
Driving Power (Max. Sig.)	2.3	1.8	0.9	0.05	watts
Plate-to-Plate Load Resistance	2700	5500	11,100	19,000	ohms
Max.-Sig. Plate Dissipation (per tube)	50	73	74	70	watts
Max.-Sig. Plate Power Output	110	205	280	325	watts

*Approximate value. Adjust to give stated value of zero-signal plate current.





PL-6569

Power Triode

The PL-6569 is a 250-watt plate dissipation high-mu power triode designed especially for grounded-grid r-f amplifier service, but also capable of good performance in other applications. Because of its high amplification factor and high perveance, the PL-6569 will give power gains as high as ten as a grounded-grid amplifier. Effective shielding is provided within the PL-6569, and neutralization is not required in ordinary grounded-grid applications.

Filament -- Thoriated Tungsten	
Voltage	5.0 volts
Current	14.5 amperes
Amplification Factor	45
Transconductance (E_b=2000 v, I_b=125 ma.)	4500 μmhos
Interelectrode Capacitances	
Grid-Filament (Input)	7.6 μμf
Grid-Plate (Output)	3.7 μμf
Plate-Filament (Feedback)	0.10 μμf

Base	Giant 5-pin, Metal Shell
Basing	See base diagram
Maximum Overall Dimensions	
Length	6.38 inches
Diameter	3.56 inches
Net Weight	8 ounces

Recommended socket -- Johnson 122-275, National HX-100, or equivalent.

January 20, 1959

PENTA LABORATORIES, INC.
312 NORTH NOPAL STREET • SANTA BARBARA, CALIFORNIA

Form No. 511

COOLING

Forced-air cooling of the base and base seals of the PL-6569 is required for all classes of operation. Such cooling normally is provided through use of a tube socket having holes which align with the holes in the tube base, and with a small fan or blower to pressurize the chassis upon which the tube is mounted. Alternatively, when an open chassis is used, a small fan or blower may be used with the outlet air stream directed at the tube socket. A minimum air flow of five cubic feet per minute through the base of the tube is required during the period that filament power is applied.

Adequate cooling of the envelope and plate seal for operation at frequencies below 30 Mc. can be obtained by convective air flow. Above 30 Mc. the air stream from a small fan or blower directed at the upper portion of the envelope normally will provide adequate cooling. In any event, the temperature of the plate cap should not be permitted to exceed 170°C for any class of continuous service.

RADIO-FREQUENCY OPERATION

The PL-6569 is especially suited for use as a grounded-grid radio-frequency amplifier. The compact construction and low plate-to-filament capacitance make neutralization unnecessary in ordinary grounded-grid applications.

A typical grounded-grid amplifier circuit is shown in figure 2. The grid is by-passed to ground, and supplied only with d-c bias voltage. Radio-frequency excitation is applied between filament and ground, and output is taken from the plate-to-ground circuit. The excitation circuit and the output circuit are in series, via the tube, and a portion of the excitation power is transferred to the output circuit. The portion of the output power "fed through" from the driving circuit is related to the ratio of tube excitation voltage to output voltage. The fed-through power is minimized by using a tube with a high amplification factor, so that minimum r-f grid voltage is required. A further improvement in the power gain of a grounded-grid amplifier is obtained by using the highest possible plate voltage, since the ratio of r-f output to excitation voltage is thereby increased.

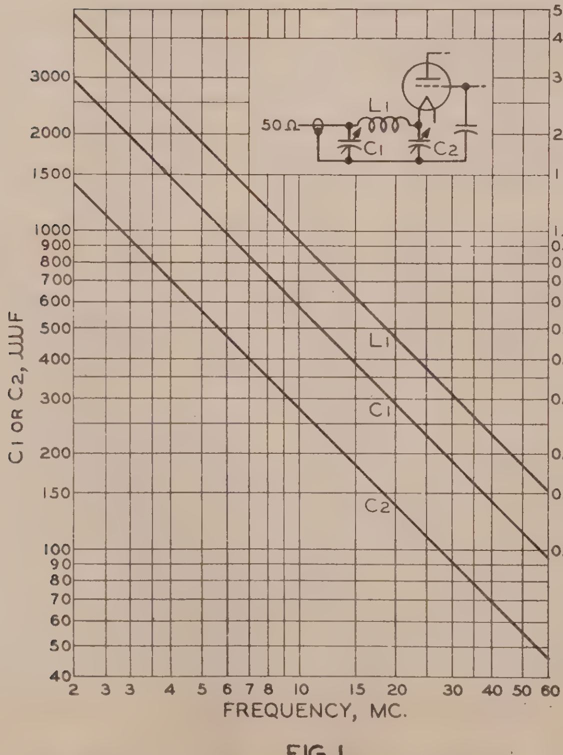


FIG. 1

In addition to the fed-through power, the r-f driving source must supply power for normal grid-driving purposes. This power is dissipated in the bias supply and at the grid of the tube, and does not appear in the output circuit. The power lost is ordinarily on the order of one-fiftieth of the output power.

The average input impedance of the PL-6569 is given by:

$$\text{Zin} = \frac{(\text{peak r-f driving voltage})^2}{2 \text{ x driving power.}}$$

Values for the peak r-f driving voltage and driving power for a number of operating conditions will be found in the tabular data. For practical purposes, the input impedance of the PL-6569 may be taken as 300 ohms in most applications.

Figure 1 shows suggested pi-network capacitance and inductance values for a network feeding the PL-6569 from a 50-ohm non-resonant line.

The grid of the PL-6569 terminates in three base pins. The corresponding three socket terminals should be connected together with a low-inductance connection, and by-passed to chassis with a short low-inductance lead and a low-inductance capacitor. Multiple by-pass capacitors may be used if desired, but will not ordinarily be found necessary.

Filament power for the PL-6569 should be supplied from a transformer having low capacitance between secondary and primary or core. A grounded electro-static shield between windings is desirable. Alternatively, an ordinary filament transformer may be used, with the filament of the PL-6569 fed through radio-frequency chokes capable of handling the approximately 15 amperes of filament current. The current requirement for the radio-frequency chokes may be reduced by placing them in the primary of the filament transformer, and isolating the transformer from ground[1].

When the PL-6569 is used as a grounded-grid linear amplifier of modulated power, the loading presented to the driving source makes additional "swamping" unnecessary. Typical operating conditions for the PL-6569 as an amplifier of single-sideband, suppressed carrier power are given in the tabular data. The typical operating conditions shown are for continuously applied sinusoidal modulation. Increased output without excessive plate dissipation may be obtained with intermittent modulation having a high ratio of peak to average power, such as normal speech. In such cases, increased plate circuit loading and increased drive should be used. The average plate dissipation should not be allowed to exceed 250 watts, except momentarily during adjustment procedures.

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[1] See, for instance, T. H. Puckett, "Notes on Grounded-Grid R. F. Power Amplifiers", QST, Dec. 1954, pg. 36.

MAXIMUM RATINGS — C C S (Continuous Commercial Service)

	Class-C FM or CW	Class-C Plate Mod.	Class-B R-F or Audio	
D-C Plate Voltage	4000	3200	4000	volts
D-C Plate Current	300	250	300	ma.
D-C Grid Current	120	120	120	ma.
Plate Dissipation	250	165	250	watts

TYPICAL OPERATION — Class-C CW or FM Amplifier

Grounded-Grid Circuit

D-C Plate Voltage	2500	3000	3500	4000	volts
D-C Grid Voltage	-70	-95	-110	-120	volts
D-C Plate Current	300	300	285	250	ma.
D-C Grid Current	85	110	90	50	ma.
Peak R-F Driving Voltage	190	225	240	230	volts
Driving Power (approx.)[1]	75	85	85	70	watts
Plate Power Input	750	900	1000	1000	watts
Plate Dissipation	250	250	250	235	watts
Power Output	555	710	805	820	watts

TYPICAL OPERATION — Class-B Linear R-F Amplifier

Single Sideband Suppressed Carrier
Grounded-Grid Circuit

D-C Plate Voltage	2500	3000	3500	4000	volts
D-C Grid Voltage[2]	-60	-75	-90	-105	volts
Zero-Sig. D-C Plate Current	40	35	30	24	ma.
Max.-Sig. D-C Plate Current[3]	300	265	270	250	ma.
Max.-Sig. D-C Grid Current[3]	80	50	68	42	ma.
Max.-Sig. Peak R-F Driving Voltage[3]	180	170	220	205	volts
Max.-Sig. Driving Power (approx.)[1, 3]	70	60	75	60	watts
Max.-Sig. Plate Power Input[3]	750	800	945	1000	watts
Max.-Sig. Plate Dissipation[3]	250	250	250	250	watts
Max.-Sig. Power Output[3]	550	600	760	800	watts

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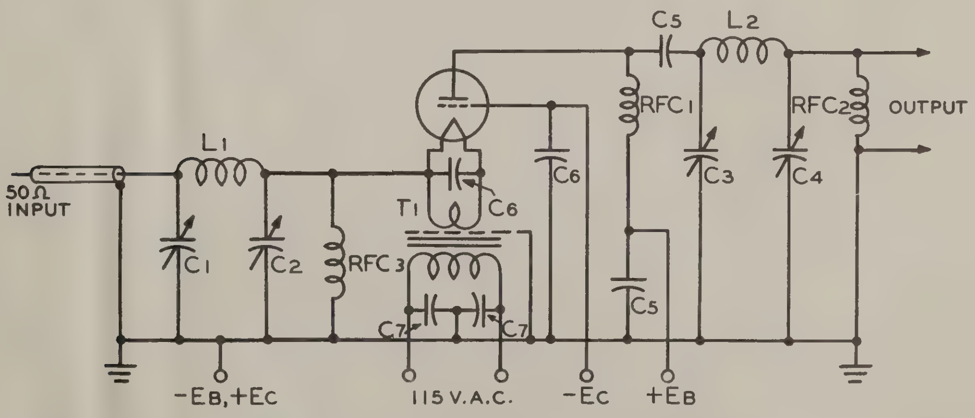
[1] Includes bias loss, grid dissipation, and feed-through power.
[2] Approximate value -- adjust to give stated zero-signal plate current.
[3] Max.-Sig. values for peak conditions, or for single-tone modulation at full signal.



C_1,C_2,L_1--SEE FIG. 1

C_3,C_4,L_2--PI NETWORK APPROPRIATE FOR OPERATING FREQUENCY

C_5--.002-ufd. HIGH-VOLTAGE MICA BLOCKING CAPACITOR

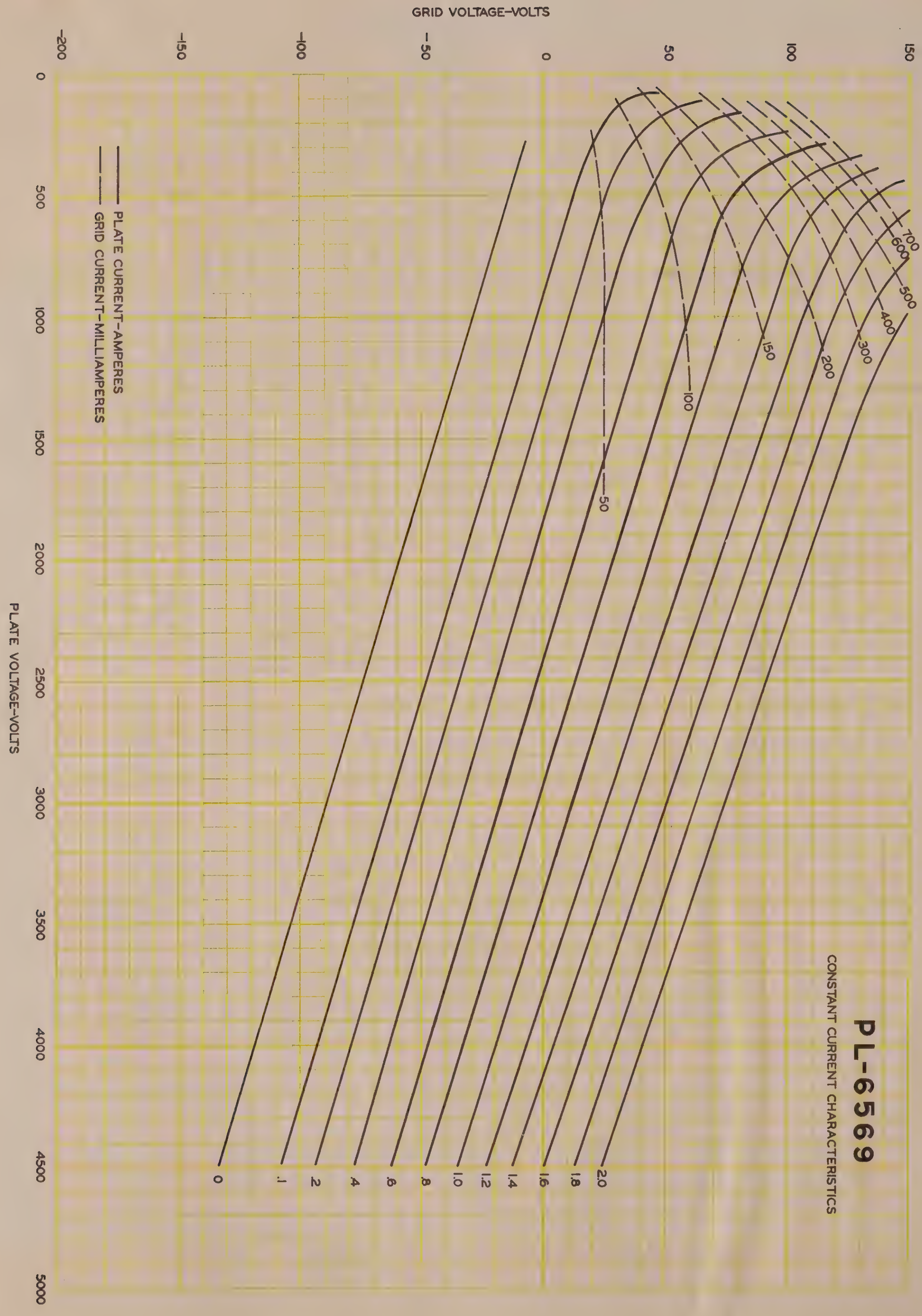
C_6--.002 ufd., 1000-VOLT MICA

C_7--.01 ufd., 500-VOLT MICA

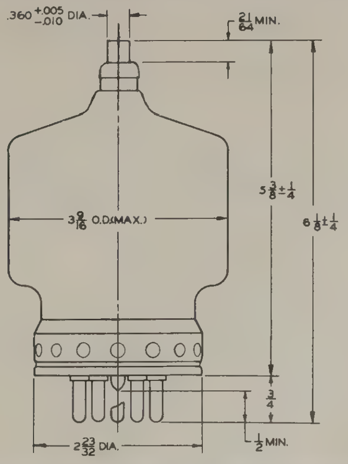
T_1--LOW CAPACITANCE TRANSFORMER 5.0 V., 15A.

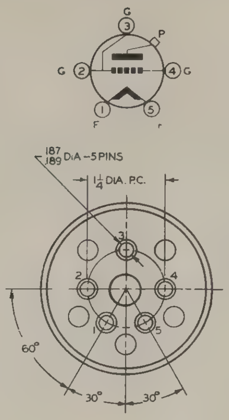
$RFC_{1,2,3}$---R-F CHOKE SUITABLE FOR OPERATING FREQUENCY

FIG. 2



PL-6569
CONSTANT CURRENT CHARACTERISTICS





PL-6580

Power Triode

The PL-6580 is a 400-watt plate dissipation high-mu power triode designed especially for grounded-grid r-f amplifier service, but also capable of good performance in other applications. Because of its high amplification factor and high perveance, the PL-6580 will give power gains as high as ten as a grounded-grid amplifier. Effective shielding is provided within the PL-6580, and neutralization is not required in ordinary grounded-grid applications.

Filament -- Thoriated Tungsten	
Voltage	5.0 volts
Current	14.5 amperes
Amplification Factor	45
Transconductance (E_b 2000 v, I_b 200 ma.)	6500 μmhos
Interelectrode Capacitances	
Grid-Filament (Input)	7.6 μμf
Grid-Plate (Output)	3.9 μμf
Plate-Filament (Feedback)	0.10 μμf

Base	Giant 5-pin, Metal Shell
Basing	See base diagram
Maximum Overall Dimensions	
Length	6.38 inches
Diameter	3.56 inches
Net Weight	8 ounces

Recommended socket -- Johnson 122-275, National HX-100, or equivalent, operated in conjunction with the PL-C1 glass chimney socket cutout as shown in this bulletin.

January 20, 1959

PENTA LABORATORIES, INC.
312 NORTH NOPAL STREET • SANTA BARBARA, CALIFORNIA

Form No. 512

COOLING

Forced air cooling of the seals at the base end of the PL-6580 is required in all classes of service. A flow of 5 c. f. m. of cooling air should be passed through the base. Where the plate dissipation exceeds 250 watts, envelope cooling is also required. Adequate envelope cooling at 400 watts plate dissipation requires 15 c. f. m. of cooling air past the envelope and across the plate seal. Proper distribution of cooling air may be obtained by the use of a type PL-C1 glass chimney, with chassis cutout as shown on page 4.

RADIO-FREQUENCY OPERATION

The PL-6580 is especially suited for use as a grounded-grid radio-frequency amplifier. The compact construction and low plate-to-filament capacitance make neutralization unnecessary in ordinary grounded-grid applications.

A typical grounded-grid amplifier circuit is shown in figure 2. The grid is by-passed to ground, and supplied only with d-c bias voltage. Radio-frequency excitation is applied between filament and ground, and output is taken from the plate-to-ground circuit. The excitation circuit and the output circuit are in series, via the tube, and a portion of the excitation power is transferred to the output circuit. The portion of the output power "fed through" from the driving circuit is related to the ratio of tube excitation voltage to output voltage. The fed-through power is minimized by using a tube with a high amplification factor, so that minimum r-f grid voltage is required. A further improvement in the power gain of a grounded-grid amplifier is obtained by using the highest possible plate voltage, since the ratio of r-f output to excitation voltage is thereby increased.

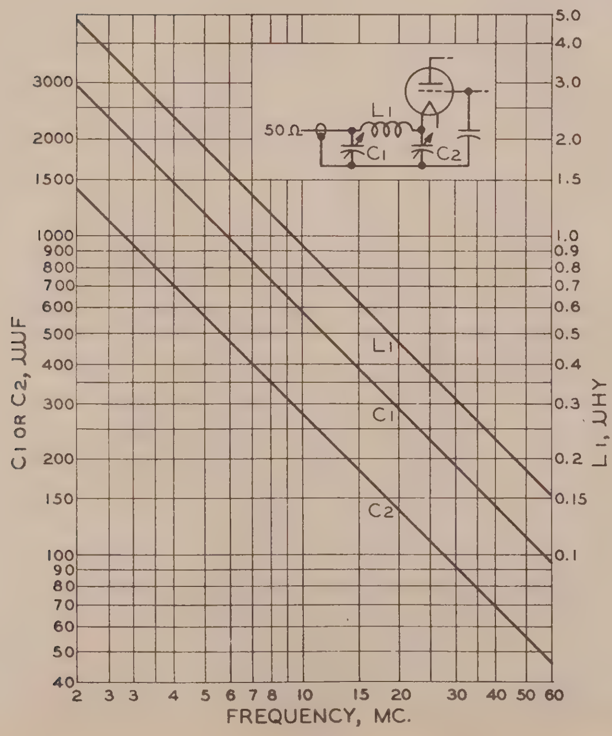


FIG. I

In addition to the fed-through power, the r-f driving source must supply power for normal grid-driving purposes. This power is dissipated in the bias supply and at the grid of the tube, and does not appear in the output circuit. The power lost is ordinarily on the order of one-fiftieth of the output power.

The average input impedance of the PL-6580 is given by:

$$Z_{in} = \frac{(\text{peak r-f driving voltage})^2}{2 \times \text{driving power.}}$$

Values for the peak r-f driving voltage and driving power for a number of operating conditions will be found in the tabular data. For practical purposes, the input impedance of the PL-6580 may be taken as 300 ohms in most applications.

Figure 1 shows suggested pi-network capacitance and inductance values for a network feeding the PL-6580 from a 50-ohm non-resonant line.

The grid of the PL-6580 terminates in three base pins. The corresponding three socket terminals should be connected together with a low-inductance connection, and by-passed to chassis with a short low-inductance lead and a low-inductance capacitor. Multiple by-pass capacitors may be used if desired, but will not ordinarily be found necessary.

Filament power for the PL-6580 should be supplied from a transformer having low capacitance between secondary and primary or core. A grounded electro-static shield between windings is desirable. Alternatively, an ordinary filament transformer may be used, with the filament of the PL-6580 fed through radio-frequency chokes capable of handling the approximately 15 amperes of filament current. The current requirement for the radio-frequency chokes may be reduced by placing them in the primary of the filament transformer, and isolating the transformer from ground[1].

When the PL-6580 is used as a grounded-grid linear amplifier of modulated power, the loading presented to the driving source makes additional "swamping" unnecessary. Typical operating conditions for the PL-6580 as an amplifier of single-sideband, suppressed carrier power are given in the tabular data. The typical operating conditions shown are for continuously applied sinusoidal modulation. Increased output without excessive plate dissipation may be obtained with intermittent modulation having a high ratio of peak to average power, such as normal speech. In such cases, increased plate circuit loading and increased drive should be used. The average plate dissipation should not be allowed to exceed 400 watts, except momentarily during adjustment procedures.

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[1] See, for instance, T. H. Puckett, "Notes on Grounded-Grid R. F. Power Amplifiers", QST, Dec. 1954, pg. 36.

MAXIMUM RATINGS — C C S (Continuous Commercial Service)

	Class-C FM or CW	*Class-C Plate Mod.*	*Class-B R-F or Audio*	
D-C Plate Voltage	4000	3200	4000	volts
D-C Plate Current	350	275	350	ma.
D-C Grid Current	120	120	120	ma.
Plate Dissipation	400	270	400	watts

TYPICAL OPERATION — Class-C CW or FM Amplifier

Grounded-Grid Circuit

D-C Plate Voltage	2500	3000	4000	volts
D-C Grid Voltage	-70	-90	-110	volts
D-C Plate Current	350	350	350	ma.
D-C Grid Current	95	82	92	ma.
Peak R-F Driving Voltage	210	215	265	volts
Driving Power (approx.)[1]	85	87	105	watts
Plate Power Input	875	1050	1400	watts
Plate Dissipation	280	375	400	watts
Power Output	660	745	1080	watts

TYPICAL OPERATION — Class-B Linear R-F Amplifier

Single Sideband Suppressed Carrier

Grounded-Grid Circuit

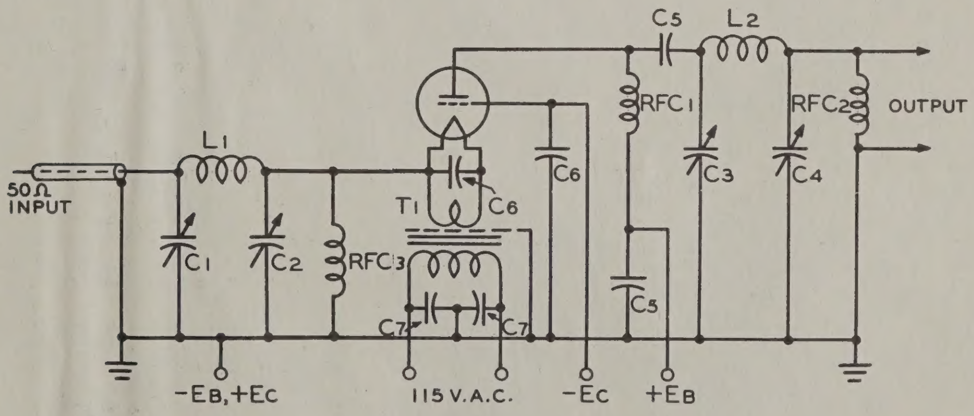
D-C Plate Voltage	2500	3000	3500	4000	volts
D-C Grid Voltage[2]	-50	-70	-85	-100	volts
Zero-Sig. D-C Plate Current	60	50	45	40	ma.
Max.-Sig. D-C Plate Current[3]	350	335	300	300	ma.
Max.-Sig. D-C Grid Current[3]	95	80	65	65	ma.
Max.-Sig. Peak R-F Driving Voltage[3]	195	205	210	230	volts
Max.-Sig. Driving Power (approx.)[1,3]	75	73	68	72	watts
Max.-Sig. Plate Power Input[3]	875	1000	1050	1200	watts
Max.-Sig. Plate Dissipation[3]	320	335	335	350	watts
Max.-Sig. Power Output[3]	610	720	765	910	watts

---

[1] Includes bias loss, grid dissipation, and feed-through power.

[2] Approximate value -- adjust to give stated zero-signal plate current.

[3] Max.-Sig. values for peak conditions, or for single-tone modulation at full signal.



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C_6--.002 ufd., 1000-VOLT MICA

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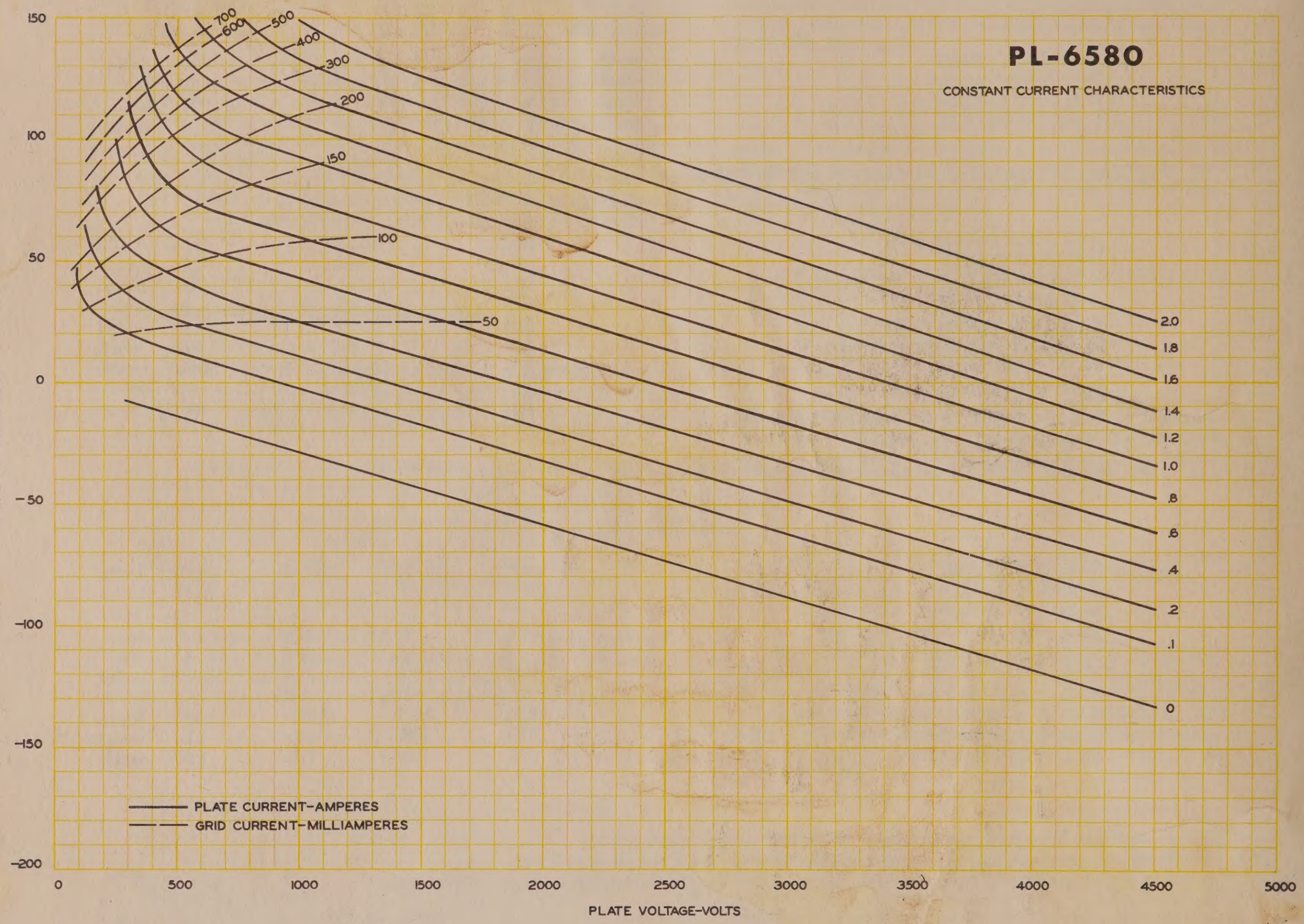
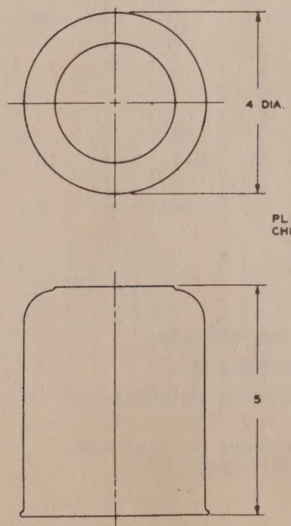
T_1--LOW CAPACITANCE TRANSFORMER 5.0 V., 15 A.

$RFC_{1,2,3}$---R-F CHOKE SUITABLE FOR OPERATING FREQUENCY

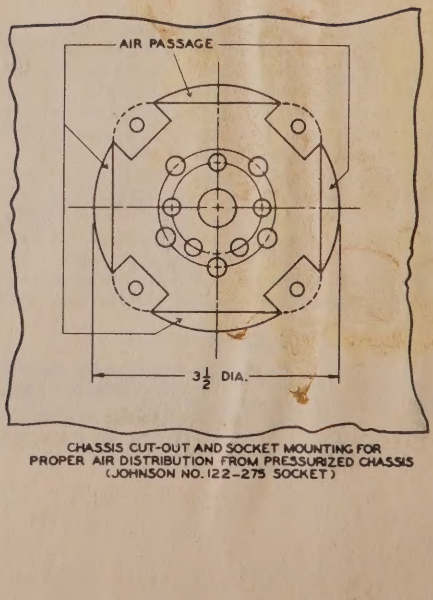
FIG. 2

PL-6580





PL-C1
CHIMNEY



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